# Railway Mechanical Engineer

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# Railway Mechanical Engineer

Volume 92 September, 1918 No. 9

## CONTENTS



**Analyze Carefully Salvageable Items**

A letter by C. J. Ruhland, a locomotive engineer, commenting on the shameful waste of rubber gaskets for air hose couplings, will be found on another page. In the past it has been quite unnecessary to give these minor articles consideration, but there are now certain materials, such as rubber, tin, etc., for which the government has great need, which puts a very different light on the situation. The demands for iron and steel are growing greater every day. We are told that there are several important industries that will have to go without them because the demand is far greater than the supply. Our reclamation program must be completely revised and brought up-to-date. Consideration of the cost of reclamation is in many cases the important factor, but in others the question is whether or not new material can be obtained under any consideration.

**The Measure of Fuel is Weight—Not Money**

In the past all fuel economy campaigns have been conducted on the basis of money saved. Today we are asked, and beseeched, and forced to save fuel for fuel's sake alone. The question now is not, can we get the money to buy the fuel, but can we get fuel to burn. The demands of the war industries, of the ships that carry our munitions and supplies, and of our Allies have taxed the available fuel resources of this country to the limit. Our government has seen to it that the price of fuel has been held down in order that every one may buy. It is our individual duty to see that none of it is wasted that every one may be supplied. The railroads use between 25 and 30 per cent of the coal mined in this country. The possibilities in economies are great—so great that the Railroad Administration has considered it necessary to appoint a Fuel Conservation Section which is attached to the Division of Operation. There is not a reader of this paper who cannot assist. Wasted power, wasted heat, wasted air, and wasted light all mean wasted fuel. Nothing is too small to be considered.

**The Freight Car Situation Is Improving**

Perhaps never before in the history of American railroading has the freight car repair situation been as serious as it has been during the past six months. The winter with its severe cold weather, coupled with inadequate shop facilities, created conditions under which it was very difficult properly to repair the cars. The spring and early summer saw these conditions further aggravated by a shortage of men. It has been extremely difficult to hold the men with the promises of better pay even though these promises were backed by the government. Now that the wage schedule has been definitely decided there has been a marked improvement in the conditions. Men who have expressed the desire to transfer into other departments are now willing to stay in the car department. The old men are coming back. There is still, however, a large amount of work to be done.

Every means must be taken to keep the largest possible number of cars in service. Some roads are finding it expedient to send repair gangs to congested points to make the light repairs to the cars in order to get them over the road. In hump yards car inspectors going over a string of

cars are told to make what repairs are possible. It will require the ingenuity of our ablest car men successfully to cope with the situation. The greatest amount of publicity should be given to methods now used to reduce the number of bad order cars. We shall welcome suggestions from any of our readers in regard to this work in order that we may pass them along for the benefit of others.

**How Can Traveling Engineers Help Win the War**

The Traveling Engineers will meet in Chicago to hold their 26th annual convention this month. The association has been authorized by the Railroad Administration to hold this meeting because of the realization that the traveling engineer, or road foreman of engines, has a very important part to play in the successful operation of our complex transportation system. The work of the traveling engineer throws him into intimate contact with the men who drive the trains, the men in whose charge is placed a machine worth anywhere from $50,000 to $100,000 and which consumes a great amount of coal; with the men whose duty it is to haul the munitions and supplies to the seaboard for shipment. In his daily contact with the enginemen and firemen the traveling engineer can, by careful coaching and instruction, exert a strong influence which will help greatly towards winning the war. He should infuse his enthusiasm and patriotism into the engine crews. He should make them realize how necessary it is to save fuel; how, because of the difficulty to get sufficient men properly to maintain the power, it should be handled carefully; he should show them what an important part they are playing in the prosecution of the war, and carry the message of his superior officers to the men on the firing line in such a manner that they will willingly and cheerfully respond to the demands made upon them. The traveling engineer has a greater opportunity than he ever had before and under existing conditions, with a shortage of fuel and material, his position is of exceptional importance. Problems concerning the new conditions at the convention will be discussed and the lessons there learned should be carried home and used to good advantage.

**Effect of the Wage Increase on Piecework**

While supplement No. 4 to general order No. 27, has granted a generous increase in wages to railway shopmen for the purpose of attracting workmen to the railway field in the hope of increasing the output of the shops, it has, by the manner in which these increases have been awarded, practically eliminated piecework and with it the incentive for the men individually, to increase their output. By not increasing piecework rates in proportion to the day work rates and by guaranteeing a minimum hourly rate of 68 and 58 cents to the men in the shops, the piecework prices are now so low, comparatively speaking, that but few men will desire to continue to work under that system.

On a number of railroads piecework, or some sort of bonus system has been developed to a high degree, resulting in greatly increased output. It has been stated that a piecework shop will turn out 33 per cent more work than a straight day-work shop. With the incentive removed for the men to work under the piecework system, it is evident that some of the beneficial effects anticipated by the wage increase will be nullified. Those to whom the advantages of piecework have been demonstrated practically should bring pressure to bear on the Railroad Administration for the sake of increased shop output and greater efficiency per man.

If the Railroad Administration should decide to perpetuate the piecework system by granting an increase in the piecework rates, and should at the same time see to it that the matter is handled in such a way that the men will have explicit confidence in the schedules and know that, regardless of how much they earn, the piecework prices will not be cut, there is no question but that a material increase in shop production will be obtained.

**The Wage Increase and the Supervising Foremen**

It was rather surprising to observe how badly the matter of increased wages to the shop foremen was handled in the recent wage revision. Gang leaders were granted five cents an hour above the workmen under their employ which is, of course, a splendid way of handling that particular class of men. The foremen of higher grades, however, were granted an increase of $40 a month. This was manifestly unfair inasmuch as many roads have postponed granting the foremen increases until definite action was taken by the Railroad Administration. Other roads have advanced the foremen with the men. Thus adding $40 to the existing salary of all foremen still maintains an unjust inequality. It is understood that this matter is still under consideration, and it is hoped that some uniformity of wage will be adopted and that the men in the supervising positions will be paid enough to hold them in that capacity and to keep them satisfied. With a weakened organization due to the high turnover of the shop forces, the need of efficient and competent supervision was never more greatly needed than it is today.

**Increase in Wages for the Railway Shopmen**

To those of the railway shop employees who have had sufficient confidence in the promises of the Railroad Administration regarding the increase in wages to remain in railway service, supplement No. 4 of general order No. 27 must be received with a great deal of satisfaction. A minimum of 58 cents an hour for the experienced carmen, and 68 cents for the experienced locomotive mechanics should fully satisfy these men. The manner in which these increases have been applied to the employees below the most experienced grades is considered entirely fair. These men are not only paid well, but are given some incentive for remaining in the employ of the railroads by being promised an increase for every year, up to four years, they remain in the railroad's employ.

To those who have remained with the railroads since the beginning of the year, a large bonus in the form of back pay is due. To some men, particularly those in the car department, this bonus will amount to a great deal. Take a car inspector, for instance, who has been working at the rate of 35 cents an hour straight time; in a thirty-day month, working 12 hours a day, he would receive $126. With time and a half for overtime over eight hours, and for Sunday, at the new rate of 58 cents an hour this same man will now receive $252.88—an increase of one hundred per cent. Further, this same inspector will receive over $1,000 back pay, including the month of August. This, perhaps, represents the greatest increase to any of the men affected. There is, perhaps, no other employee in the mechanical department that is deserving of as much consideration. The *Railway Mechanical Engineer* has always contended that the car inspector has been greatly underpaid. The wages of the shopmen on the locomotive side have of necessity been increased from time to time in order to hold men, and while the new rates represent very nearly one hundred per cent increase over those in effect three or four years ago, the net change from the conditions as they existed the early part of this year, will only be about 30 per cent.

The question which naturally arises in the minds of the

shop supervisors and of the railway mechanical department officers, is—What will be the effect of this increase on shop output? Of course a larger number of men will be attracted to railway work. But will they work full time? There are some classes of men who cannot stand prosperity—nor a bank account. When they have plenty of free money on hand they feel uneasy until it is spent. It is this class that must be carefully watched if the desired effect of the increase—namely, to increase the output of the shops by attracting more expert labor—is not to be neutralized. It will take considerable missionary work on the part of the supervising officers to keep these men on the job. The foremen particularly should co-operate in this work.

There are plenty of ways in which this extra money can be spent to good advantage. There is no better investment for the workman than the purchase of government War Saving Stamps, or Liberty Loan Bonds. The fourth loan, for the largest amount yet requested by the government, is soon to be floated. The men should be encouraged to hold on to the surplus funds until the opportunity comes for subscribing to that loan. If the workmen of their own volition do not remain at work, there is the danger of conscription of labor which the public will demand if the men attempt to take advantage of their strategic position and slight the work. This none of us want and if every man will keep before him President Wilson's Labor Day address and bring himself to believe, as he rightfully should, that this war is *his* war there should be no occasion for any such measures.

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**Good Illumination Promotes Shop Efficiency**

In a recent article a representative of an accident insurance company estimated that twenty-five per cent of all the accidents occurring in and about industrial plants in the United States were due to poor lighting. It has also been estimated that the entire cost of adequately lighting all the industries of this country would be less than the yearly cost of accidents now occurring due to poor illumination. As a safety measure alone good lighting is economical. There are other reasons why railroad shops should have efficient illuminating systems. During the winter the shops operate a large part of the time by artificial light, and unless proper illumination is furnished the output will be far below that secured when working by natural light. The extent to which lighting affects production is shown by the case of a large factory in which individual incandescent lamps were replaced by a system of general illumination. The output per man increased sixteen per cent, which was attributed solely to the change in the lighting system.

An inspection of a few typical railroad shops will make it evident that most of the lighting installations were made with great regard for saving electricity, but with little thought of the effect of lighting on shop efficiency. The ordinary drop light, even when properly maintained, provides poor illumination. If a film of grease is allowed to accumulate on the globes the efficiency is reduced forty or fifty per cent. A good lighting system should provide even distribution of light of the proper intensity, varying with the nature of the work. The light should not flicker and there should be no brilliant source of light within the field of vision. Localized lighting is unsatisfactory except as a supplement to general illumination.

By comparison with the cost of wages the expense of adequate lighting is almost negligible. The cost of current for this purpose amounts to only about one per cent of the labor cost. A saving of two to five minutes time per day for each worker will more than pay the cost of the installation. Under these conditions there are many shops and roundhouses where improved lighting systems will bring large returns.

## NEW BOOKS

*Proceedings of the Air Brake Association.*—Edited by F. M. Nellis, secretary. 275 pages, 6¼ in. by 8½ in., illustrated, bound in cloth. Published by the association, 165 Broadway, New York.

This book contains the proceedings of the twenty-fifth annual convention of the Air Brake Association which was held at Cleveland, Ohio, May 7 to 9, 1918. The subjects discussed at this meeting were slack action in long passenger trains; the safe life of an air brake hose; the best methods of preparing air brakes at terminals to avoid train shocks and break-in-twos; 8½-in. cross-compound compressor maintenance; the feed valve—its operation and maintenance; M. C. B. brake stenciling for cleaning, etc.; and changes in recommended practice.

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*The Calorific Value of Fuels.* By Herman Poole, F. C. S., third edition, rewritten by Robert Thurston Kent, M. E. 267 pages, illustrated, 6 in. by 9¼ in., bound in cloth. Published by John Wiley & Sons, Inc., 432 Fourth avenue, New York. Price $3 net.

This book, while based on the second edition of the late Mr. Poole's work which was published in 1900, has been practically rewritten to incorporate the latest researches not only on coal, but on fuels which to a great extent have replaced or supplemented coal. Revision has been made of some of the work of investigators which was published in the first edition and which now is generally discredited. It has been prepared to cover every industry which uses fuel.

It contains five chapters on the various methods of measuring the calorific value of fuel. Three chapters are given to the discussion of all kinds of solid fuels, liquid fuels and gaseous fuels. One chapter contains a discussion on the combustion of coal, one on the calorific power of coal burned under a steam boiler and another on the analysis and measurement of the products of combustion. An appendix is added, in which are included the A. S. M. E. boiler test code and tables of interest in the study of fuels. The book is well illustrated, and Mr. Kent in his revision has availed himself of the latest studies made of this subject.

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*Lubricating Engineer's Handbook.* By John Rome Battle. 6 in. by 9 in., 333 pages, bound in cloth. Published by J. D. Lippincott Company, Philadelphia, Pa. Price $4 net.

This book has been compiled from notes and data collected by the author during a long period of engineering service in the oil business. It covers the whole subject of lubrication and the special requirements of various conditions under which lubricants are required to perform their function. The subject matter has been arranged in five parts. Part I deals with the theory of friction and lubrication, and contains a brief sketch of the origin and history of petroleum. The manufacture of lubricants and grease and the methods of testing lubricants are also described. Part II contains a miscellaneous collection of data most of which will be found useful in making calculations involving the volumes and weights of lubricants. Chapters are also devoted to brief descriptions of various mechanical processes and classes of power machinery in which lubrication is required. The six chapters of Part III are devoted to an elementary discussion of the various types of bearings and methods of lubrication, including descriptions of lubricating equipment and oil house methods, and closing with a chapter on the uses of the steam indicator. Part IV contains 21 chapters, each of which deals with the lubricating problems of a specific type of machinery or prime mover, such as air compressors, automobiles, internal combustion engines, motors and dynamos, railway locomotives and cars, hydro-electric equipment, etc. Cost of lubricants and their specifications are treated in Part V. The book is well illustrated and, while the title is somewhat misleading in that the arrangement, size and binding are not of the usual handbook type, it is probably the most comprehensive collection of thoroughly practical data available on the subject of lubrication.

# COMMUNICATIONS

## SAVE THE RUBBER GASKETS

OSAWATOMIE, Kan.

TO THE EDITOR:

I have read with much interest the article by Mr. Miller on the prevention of waste vs. reclamation of scrap which was published in the August issue of the *Railway Mechanical Engineer,* on page 407. It made me think of the manner in which air hose gaskets are being wasted. With the high cost of and scarcity of rubber, it is a shame the way the car and locomotive inspectors throw the old gaskets away when replaced. In every switching yard I have been in I have seen rubber gaskets lying around on the ground. I believe this should be stopped. Inspectors should be required to turn them in at the end of their inspection trips. A visit to any yard will show you just how much this amounts to.

C. J. RUHLAND.

## DON'T REDUCE WASHOUT TIME TOO MUCH

TRANSCONA, Man.

TO THE EDITOR:

In his article, entitled "Reducing the Time to Turn Locomotives," which appears in your February number, T. T. Ryan says that: "With a proper hot water washing plant the boiler should be washed and made hot in four hours." I do not consider that it is possible to save as much time in washing out boilers as this statement indicates.

The average locomotive in bad water districts will have from 35 to 45 washout plugs, and possibly hand hole plates in addition. For a thorough washout, these plugs should be removed, and when you consider that it is impossible to get men to work with washout water which is much over 140 deg. F., and that the temperature of the boiler when it comes into the roundhouse is 300 deg. or over, you will acknowledge, I think, that four hours, even with a first-class hot water washout system, is too short a time for washing out and lighting up an engine. Even if the washout part of the work were properly done, the cooling and heating of the boiler would be altogether too rapid, especially with the large amount of welding which we now have in fire boxes.

C. E. BROOKS,
Supt. Motive Power, Grand Trunk Pacific.

## T. W. GIVES SOME ADVICE

*(With Apologies To Wallace Irwin)*

A LAKE MICHIGAN PORT

HON. EDITOR:

I have experience quite an exhilaration recent which I assume to recite for your delectivity. I were idle hunting cooties while sitting in lobby of Whitestone Hotel (this are place where I board when in this city) when I receive message (collect) from friend secretary of a Local 41144 to come quick as he have discover case.

Next evening find me in northern (delete) town at leading hotel while await arrival of friend with sensation. He appear soon and express concern to have me ride with him next day to this city on his regular engine. Next morning I are all equipt with overalls, smoke helmet and gogles to endure trouble, as I surmise this are to be no joy ride. I board hog and esconce my person behind engineman with eyes and ears alert for danger. I think we have about ½ mile of cars and late model full crew combination sleeping, dining and club or caboose. We start in on one side, other side follow soon. First thing I perceive is that this are new kind of cylinder arrangement as she have five exhaust in one cycle. Sec'y explain this by saying rings gone one side which results in two half notes instead of one whole note. I are unable to reply further intelligible so ask why we are favored with decisive drop each revolution. Explanation are to-wit verbatum—"Those flat spots were accumulate by extra crew which come half way down hill, all wheels lock on sand. They ain't bad, however, as I are able to roll them out in three round trip easy." I volunteer soft that it are good job for dentist. Next thing I remark were when drifting down long slope and using air brake gradual. The motion are like starting Ford on cold morning when about half machinery missing or riding camel with long wheel base. Engineer admit with reluctance that wedge can no more be set up without applying liner.

One more idiosyncrasy happen when we turn corners. The locomotive keep on straight line while wheels turn on rail. After a period, front end swing over while tail go over in big jump. I inquire how much lateral exist and friend blush while acknowledge 2 in. ahead, 1½ in. on all drivers and 2¼ in. on trailer. The reason for excess behind are account hub liner drop off each side last trip.

This lateral accomplish following result. As we make a turn once she do not seem able to follow rail except all of a sudden. At this instant I alight in full crews lap while engineer land at my feet on shaker post. He immediate climb back to regular position, and apologize to me with subdued eyes. At invitation I return to his seat box with strong resolution about "joy-ride" on antiquate r.r.

Soon after we arrive at junction and are prepare to go through at 40 mile per hour. Assuming we take straight track I feel secure. However, engine suddenly careen fierce and take turn-out. At same second I. C. C. detector consume six feet between deck and bottom step and are prepare to unload on windward side when engineer grab him by top of head and order him return to cab. I return with clenched fist and eyes ablaze to inquire what he mean by taking turn-cut at high speed. All wheels on this side are by now return to rail. He grin effusive and acknowledge ignorance on subject. He explain that he go in some time one way and some time other, and that he propose this time to go straight ahead, but tower man decide different and throw him on cut-off. He say, of course it are not assume to go round there 40 m.p.h. but that since it are happen, he realize how much better engine ride. He explain that all lateral have remove to one side, which avoid tail-slap experience previous, and make ride around curve smooth to compare. I have resolve to stand up remainder of trip and alight when first see city car. We soon approach ship-canal with draw-bridge and account block are require to stop. I collect baggage and set date for eight o'clock my hotel.

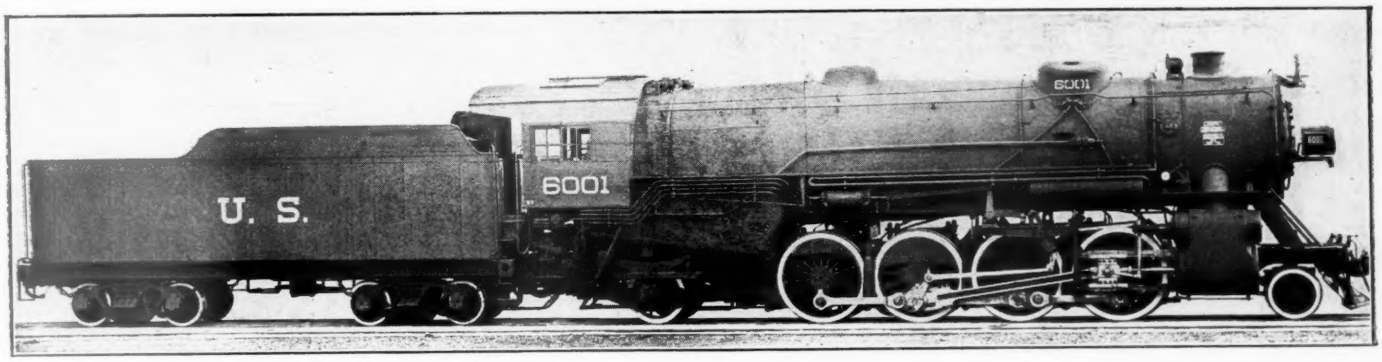
When friend secretary approach me at 8 kp. he appear combination sheepish and serious. I resolve to do talking and recite following:

"I have assume you retain me in capacity friend instead of Federal detector, therefore my advice are so. Arrange compact yourself, fireboy and full crew. Next time you approach ship canal in dark or fog with open bridge, see white light, then open wide on beast. Just before approach cruel waters, reverse, throw her over to big hole and unload. SPURLOS VERSANKT—you will have new engine next trip or new job. Good night."

Yours truly,

TOBESURA WENO.

COMPARATIVE EVAPORATION OF OIL, COAL AND GAS.—According to the United States Geological Survey, 1 lb. of oil, under favorable conditions, will evaporate from 14 to 16 lb. of water from and at 212 deg., 1 lb. of coal will evaporate from 7 to 10 lb., and 1 lb. of natural gas, from 18 to 20 lb.




# Heavy Standard Mikado Locomotive

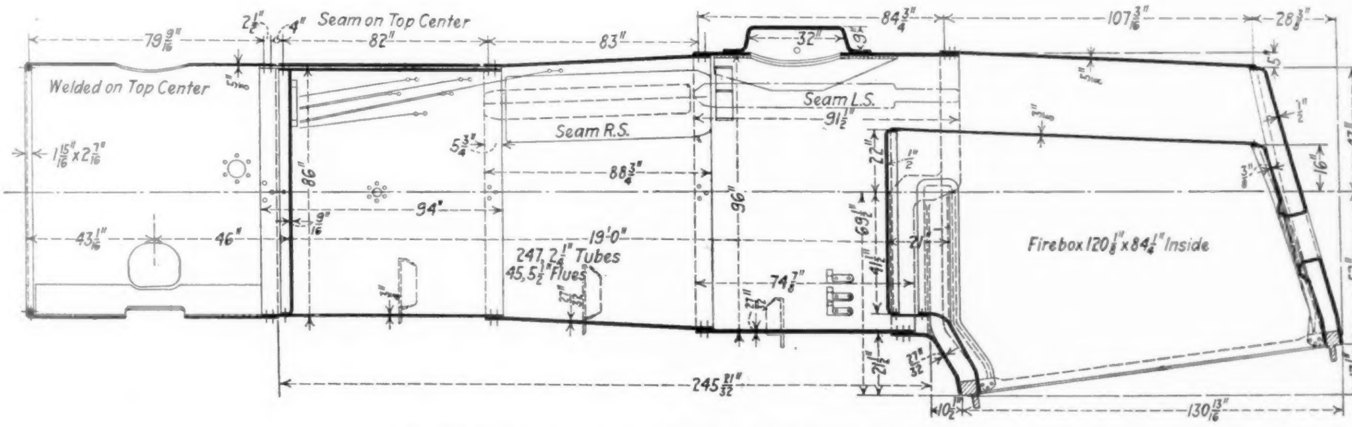
**Second Set of Locomotives Built to the Government's Specifications by the American Locomotive Company**

The first of the 157 standard locomotives of the heavy Mikado type to be built for the United States Railroad Administration has been completed at the Brooks works of the American Locomotive Company. The heavy Mikado type is the second of the standard types to be placed in service, locomotives of the light Mikado type having already been built.* With the exception of the light Mikado type, of which 575 have been ordered, the 157 engines of the heavy Mikado type constitute the largest number of any of the other standard types which have been ordered this year.

The design of the heavy Mikados, like that of the light Mikado type, adheres closely to well established practice and is conservative both in the proportions and in the design of details. As far as practicable, interchangeability of details of the type A superheaters with which the engine is equipped. The boiler is fitted with four 3-in. Cole safety valves and the Chambers throttle.

The firebox is the same width as that of the light Mikado type, but an increase of 6 in. in length provides a great area of 70.8 sq. ft. as compared with 66.7 sq. ft. in the light Mikado boiler. The firebox is fitted with a Security brick arch, and the Shoemaker fire door. The locomotive is fired by a Standard stoker and is fitted with the Franklin grate shaker. The ashpan has two center hoppers, with swinging drop bottoms, both located forward of the trailer axle. The air opening below the mudring is about 5½ in. wide.

A comparison of the boiler capacity with the cylinder demand on the basis of Cole's ratios shows a slightly better than




The Boiler for the U. S. Heavy Mikado Type Locomotive.

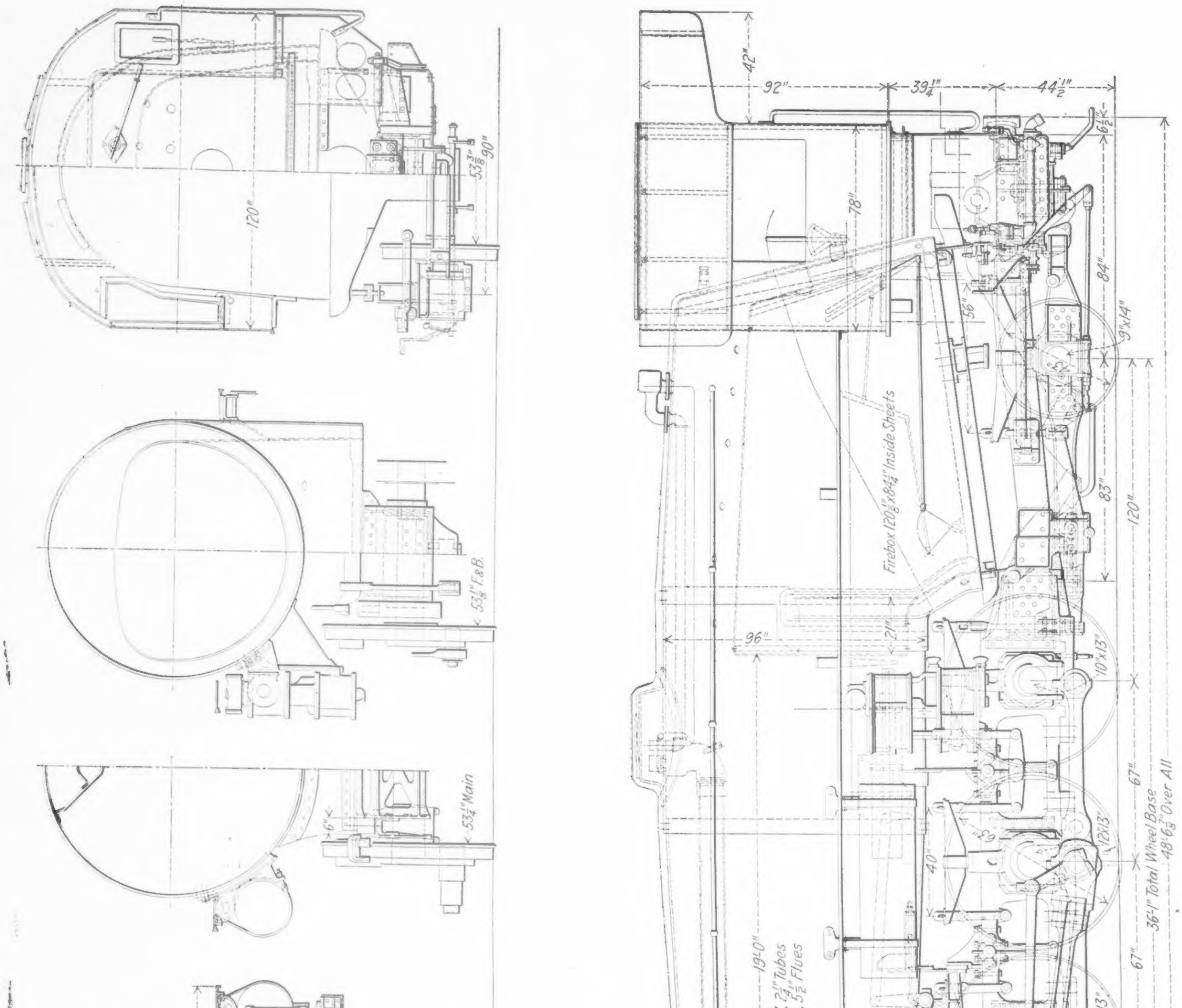
has been maintained between the various types and a number of those parts on the light Mikado will be found exactly duplicated on the heavy Mikado type.

The boilers are of the conical wagon top type, with a diameter of 86 in. at the front course, increasing to a maximum diameter of 96 in. for the dome course. Comparing this boiler with that of the light Mikado type, it will be seen that the tube sheet is set back 3 in. farther from the center line of the cylinder saddle than in the lighter engine, and that the combustion chamber is 21 in. instead of 24 in. deep, the length of the tubes being 19 ft. in both cases. There are 247 2¼-in. tubes, and forty-five 5½-in. flues for the units

100 per cent boiler, both in heating surface and grate area.

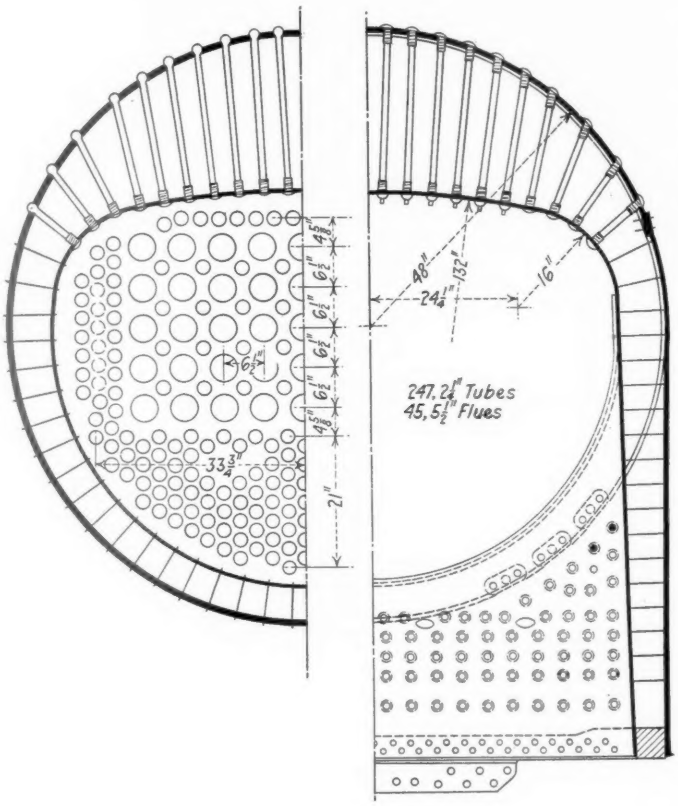
The frame construction compares very closely with that of the light Mikado type locomotive. The main frames are of cast steel, 6 in. wide, and include single integral front rails. Over the pedestals the top rail has a depth of 6¾ in., while the lightest section between the pedestals is 5¾ in. in depth, these being one-eighth inch thicker than similar sections of the light Mikado frames. Over the binders the lower rails are 4⅝ in. deep, and have a minimum section 4⅛ in. deep. Under the cylinders the frames are of slab section 6 in. wide by 10¼ in. deep. At the front ends where the front deck casting is attached the section is reduced to a depth of 10 in. by 3½ in. in thickness. The wheel spacing of both types is identical, as is also the distance between the center of the cylinder saddle and the first pair of drivers and

* For a description of the United States Railroad Administration standard light Mikado type locomotive see the *Railway Mechanical Engineer*, for August, page 436.




Elevation and Cross Sections of the United States Standard Heavy Mikado Type Locomotive

that between the center lines of the rear drivers and the trailing truck axle. The trailer frames are separate steel castings, each of which is attached to one of the main frames with fourteen 1¼-in. bolts, the joint being the same as that




Sections Through the Combustion Chamber and Firebox

employed on the light Mikado type locomotives. At the rear end the trailer frames are bolted to the rear deck casting.

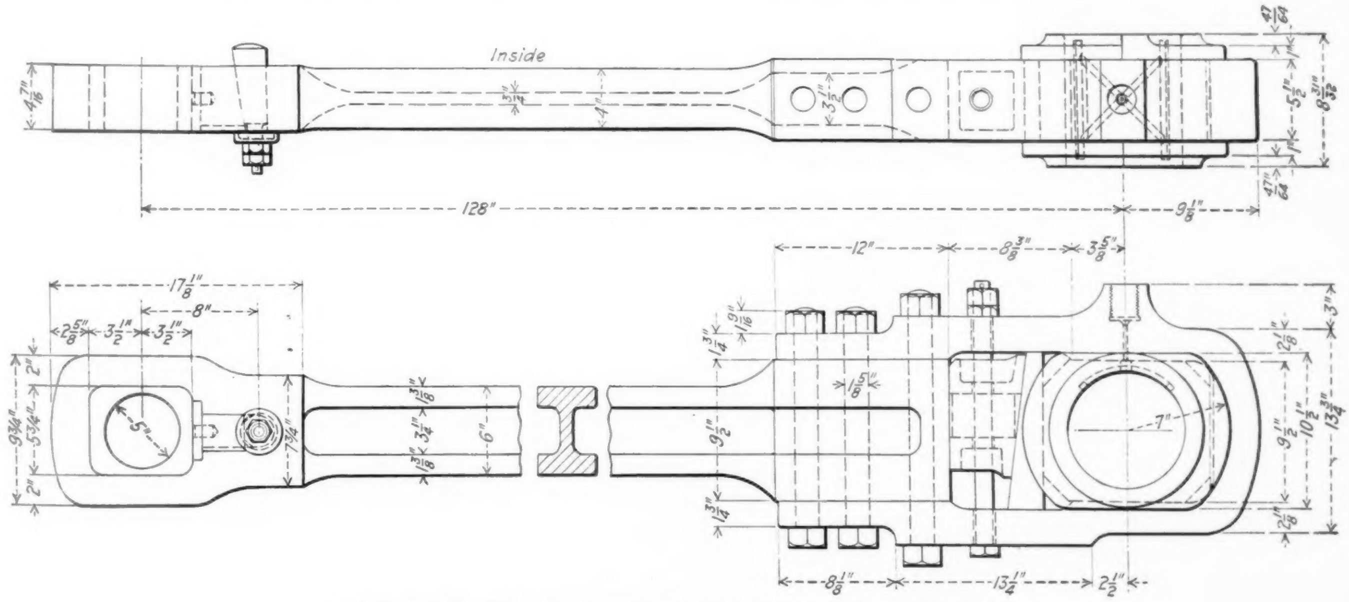
The frame bracing of the two types is practically identical. It consists of vertical crossties bolted to the front legs of the forward driving wheel pedestals and to the rear pedestals of the second and third pairs of drivers; and deck braces applied to the top rails between the first and second and the third and fourth pairs of drivers. The forward vertical brace includes a diagonal extension which is bolted to the lower frame rails just back of the cylinders, and in which is also included the radius bar pivot for the front engine truck and the driver brake fulcrum. Cast steel driving boxes of straightforward design, fitted with grease cellars, are used throughout. With the exception of those for the main axle, the boxes and axles are all interchangeable with those used on the light Mikado type locomotive, the journals being 10 in. in diameter by 13 in. in length. The main journals are 12 in. in diameter by 13 in. in length, or 1 in. larger in diameter than those of the lighter locomotive. The driving wheels are fitted with brass hub liners.

With the exception of the springs, which are heavier for the heavy Mikado type, the Economy constant resistant engine trucks are interchangeable on the two types. The heavy Mikado type is fitted with Cole-Scoville trailer trucks.

Gun iron bushings are fitted in the cylinders and valve chambers and the packing rings are of the same material. The steel pistons are of single plate sections to which are bolted gun iron wearing shoes. The details of the valve motion follow very closely those of the light Mikado type, the same piston valve and link being used in both cases. The valve chamber heads are also interchangeable. With the exception of the slight difference in the clearance for the front end of the main rod and crosshead pin the crosshead body is identical on both types. The wearing shoes, which are of Hunt-Spiller gun iron, differ in dimensions on the locomotives, but are of the same general style. The valve gear is of the Walschaert type and is fitted with the Lewis power reverse gear. Paxton-Mitchell packing is used for the piston rods and valve stems.

The standard 10,000-gal. tender which is used with the heavy Mikado type is identical with that in use with the light Mikados, and will also be used on several other of the standard types. The design of this tender was briefly outlined in the description of the light Mikado type locomotive. It is carried on four-wheel trucks with 6-in. by 11-in. journals, and among the specialties with which these trucks are fitted it may be of interest to note that the brakebeams are carried on the Creco three-point support and that Woods side bearings are used.

The main rods are of heavy channel section and differ in




Main Rod for the Government's Standard Heavy Mikado Locomotive

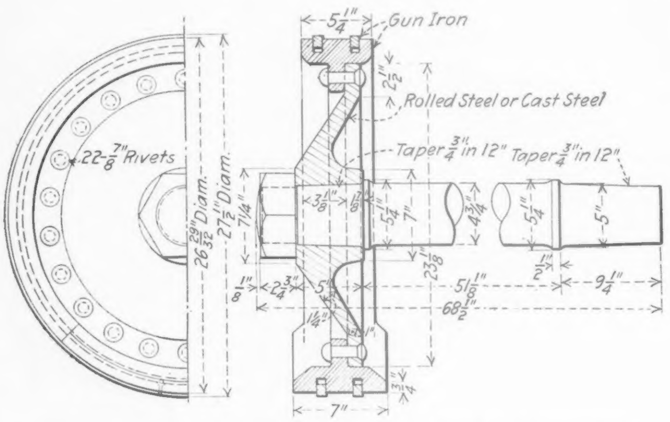
but very few dimensions from those of the standard light Mikado. The stub ends are of the strap type with removable crank pin brasses.

The specialties with which these locomotives are fitted include Everlasting blowoff valves, Ashcroft gages, the Detroit

six-feed lubricator, Hancock No. 11 non-lifting injectors, Barco flexible connections between the engine and tender, the Barco blower fitting, Sargent quick-acting blower valves, and the Radial buffer and Unit safety bar between the engine and tender. The following are the principal data and dimensions of these locomotives:

*General Data*

| | |
|---|---|
| Gage | 4 ft. 8½ in. |
| Service | Freight |
| Fuel | Bit. coal |
| Tractive effort | 60,000 lb. |

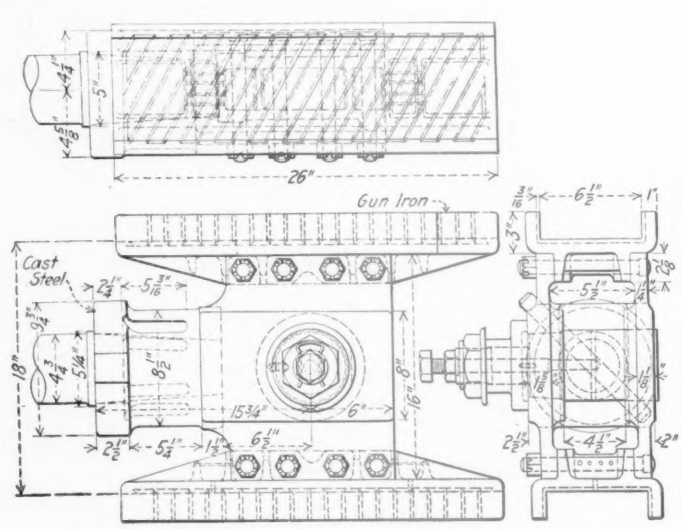



**Pistons for the U. S. Standard Heavy Mikado Locomotive.**

| | |
|---|---|
| Weight in working order | 325,000 lb. |
| Weight on drivers | 240,000 lb. |
| Weight on leading truck | 28,000 lb. |
| Weight on trailing truck | 57,000 lb. |
| Weight of engine and tender in working order | 497,000 lb. |
| Wheel base, driving | 16 ft. 9 in. |
| Wheel base, total | 36 ft. 1 in. |
| Wheel base, engine and tender | 71 ft. 9½ in. |

*Ratios*

| | |
|---|---|
| Weight on drivers ÷ tractive effort | 4.0 |
| Total weight ÷ tractive effort | 5.4 |
| Tractive effort × diam. drivers ÷ equivalent heating surface* | 653.2 |
| Equivalent heating surface* ÷ grate area | 81.7 |
| Firebox heating surface ÷ equivalent heating surface,* per cent | 5.5 |




**Crosshead for the U. S. Standard Mikado Locomotive.**

| | |
|---|---|
| Weight on drivers ÷ equivalent heating surface* | 41.5 |
| Total weight ÷ equivalent heating surface* | 56.2 |
| Volume both cylinders | 21.2 cu. ft. |
| Equivalent heating surface* ÷ val. cylinders | 272.9 |
| Grate area ÷ vol. cylinders | 3.3 |

*Cylinders*

| | |
|---|---|
| Kind | Simple |
| Diameter and stroke | 27 in. by 32 in. |

*Valves*

| | |
|---|---|
| Kind | Piston |
| Diameter | 14 in. |
| Greatest travel | 7 in. |
| Outside lap | 1⅛ in. |
| Inside clearance | 0 in. |
| Lead in full gear | 3/16 in. |

*Wheels*

| | |
|---|---|
| Driving, diameter over tires | 63 in. |
| Driving journals, main, diameter and length | 12 in. by 13 in. |
| Driving journals, others, diameter and length | 10 in. by 13 in. |
| Engine truck wheels, diameter | 33 in. |
| Engine truck, journals | 6½ in. by 12 in. |
| Trailing truck wheels, diameter | 43 in. |
| Trailing truck, journals | 9 in. by 14 ft. |

*Boiler*

| | |
|---|---|
| Style | Con. wagon top |
| Working pressure | 190 lb. per sq. in. |
| Outside diameter of first ring | 86 in. |
| Firebox, length and width | 120⅛ in. by 84¼ in. |
| Firebox plates, thickness | Sides, back and crown, ⅜ in.; tube, ½ in. |
| Firebox, water space | Sides and back, 5 in.; front, 6 in. |
| Tubes, number and outside diameter | 247—2¼ in. |
| Flues, number and outside diameter | 45—5½ in. |
| Tubes and flues, length | 19 ft. |
| Heating surface, tubes and flues | 3,978 sq. ft. |
| Heating surface, firebox, including arch tubes | 319 sq. ft. |
| Heating surface, total | 4,297 sq. ft. |
| Superheater heating surface | 993 sq. ft. |
| Equivalent heating surface* | 5,787 sq. ft. |
| Grate area | 70.8 sq. ft. |

*Tender*

| | |
|---|---|
| Tank | Water bottom |
| Frame | Cast steel |
| Weight | 172,000 |
| Wheels, diameter | 33 in. |
| Journals, diameter and length | 6 in. by 11 in. |
| Water capacity | 10,000 gal. |
| Coal capacity | 16 tons |

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

# INTERESTING NEWS FROM THE RAILROAD ADMINISTRATION

The Mechanical Department of the Division of Operation has announced the following promotions: John F. Tatum has been appointed general supervisor of car repairs; F. P. Pfahler, who has hitherto borne the title of mechanical engineer, has been made chief mechanical engineer; John McManamy and George N. De Guire, assistant supervisors of equipment, have been made, respectively, general supervisor of equipment, west, and general supervisor of equipment, east. The appointments were all effective August 3 and all the appointees will have headquarters at Washington.

## LOCOMOTIVE SITUATION

The requirements of our armies in France, including the order placed during the month with the Baldwin Locomotive Works for 510 additional 80-ton Consolidation locomotives, will delay somewhat the progress in delivery of the Railroad Administration's standard locomotives for use on this side of the water, of which 1,430 have been ordered. At the same time the Railroad Administration is preparing to take out of service the 135 similar locomotives which were built for our armies in France and turned over to eastern roads last winter. These locomotives will be sent to the Baldwin Locomotive Works, which built them, to be put into shape ready for transportation overseas at the rate of five a week until the entire lot is turned over.

To overcome the insufficient building capacity the War Industries Board, in conference with the locomotive builders and officers of the Railroad Administration, have made plans whereby the output of the locomotive shops will be increased to 6,000 engines a year. The output will be divided about half to Pershing and the Allies and half to the Railroad Administration.

It is reported that the mechanical department of the Railroad Administration expects to compensate for the delay in the construction of the standard locomotives and the withdrawal of the army locomotives from service here by the special efforts which it has been making since last winter to rush the repair of domestic locomotives. A large number of these locomotives are already in shape and are in white lead, ready for next winter. Several of the standard locomotives have already been delivered.

## STANDARD CARS

Progress on the standard cars is considered favorable. The first completed standard cars are expected to be delivered

the first week in September and to continue regularly after that. It is not expected that the order for cars recently placed for the American forces overseas will hinder the production of the cars for the Railroad Administration.

The Committee on Standards for Locomotives and Cars, of which Frank McManamy is chairman, held a meeting recently to go over specifications for standard baggage and express cars and coaches. It also examined plans covering these types of cars recently prepared by the builders and presented through the committee of the builders, of which J. M. Hansen of the Standard Steel Car Company is chairman. The specifications and drawings should be ready in a short time, after which negotiations will be begun for their purchase. It is not unlikely that two designs of coaches may be considered, one for through trains and one for suburban service, although the last will probably be a later development.

#### DRAFT CLASSIFICATION OF SKILLED RAILWAY MEN

Provost Marshal General Crowder has sent a message to all draft officials requesting reconsideration of the classification of railway men in Class I. Reconsideration is especially asked in the case of applicants employed as machinists, blacksmiths, boilermakers, tin and coppersmiths, pipefitters and helpers and apprentices of all of the foregoing, hostlers, enginehouse men, train despatchers and directors, telegraphers, telephoners, and block operators, locomotive firemen and helpers, conductors, yard foremen, brakemen, track foremen, telegraph clerks, yardmasters and assistants, locomotive engineers and motormen.

Application should be made by the individual and filed with the district board or the local board for transmission to the district board, asking reconsideration of classification on the ground that the applicant is engaged in a necessary industrial enterprise as a skilled laborer especially fitted for the work in which he is engaged, or as a highly specialized technical or mechanical expert, as the case may be. In case an individual does not wish to make application or it is impracticable for him to do so, application may be made by the federal manager, general manager or other representatives of the Railroad Administration. Applications should be supported by affidavits made by representatives of the Railroad Administration preferably not below the rank of division superintendent.

#### MISCELLANEOUS ITEMS

*Headlights for Switching Engines.*—At the meeting of the Committee on Standards for Locomotives and Cars which was held in Washington recently the question of suitable headlights for switching locomotives was discussed and it was unanimously agreed by members present that electric headlights are more efficient and economical than any other type of headlight. The regional directors have, therefore, been advised to express to their federal managers the desire that when necessary to make changes in headlights on switching engines to meet the requirements of the law or on account of renewals they be equipped with a headlight of the incandescent type with a turbo-generator and the bulb of suitable wattage.

*Mechanical Stokers.* — The eastern regional director is asking for the following information from each road; number of locomotives of 45,000 lb. tractive power or more; how many are now equipped with mechanical stokers; type of stoker; what is policy or recommendation regarding the application of stokers to the balance of the locomotives of above mentioned capacity.

*Conserving Materials.*—The eastern regional director directs attention to the necessity of reclaiming as far as practicable all iron and steel parts and suggests that the use of oxy-acetylene and electric welding outfits should be increased.

*Transfer of Bad Order Cars.*—The southern regional director has emphasized the necessity for sending in to the regional director detailed information concerning cars that are being sent from one road to another for repairs, in order to relieve the bad situation on various roads.

## FUEL CONSERVATION SECTION ACTIVITIES

The Fuel Conservation Section of the Division of Operation has completed its organization and now includes Eugene McAuliffe, as manager, and Major E. C. Schmidt, assistant to the manager; Robert Collett, assistant manager and supervisor for the eastern region; Howard C. Woodbridge, supervisor, Allegheny Region; Harry Clewer, supervisor, Pocahontas Region; Bernard J. Feeney, supervisor, Southern Region; Frank P. Roesch, supervisor, Northwestern Region; Leslie R. Pyle, supervisor, Central Western Region, and J. W. Hardy, supervisor, Southwestern Region. The supervisors will give special attention to the conservation of fuel used on locomotives, in shops, at terminals, at water stations, and for all miscellaneous purposes. They will also give attention to the preparation of fuel received and to its quality; and they will make investigations and recommendations with respect to its transportation to and its handling at fuel stations.

#### CIRCULARS NOS. 8, 9, AND 10

Fuel Conservation Circular No. 8, addressed to motive power officers concerned with locomotive maintenance, draws attention to certain sources of fuel loss which can be remedied by proper locomotive maintenance, and reads as follows:

> The inspection of locomotive front-ends on certain roads shows that there is a marked variation in the size of exhaust nozzles. In many instances exhaust nozzles have been decreased in size because of the presence of air leaks in the front-end, which of course partially destroys the vacuum and necessitates excess draft. Such leaks can be readily located when the engines are under steam or when they are located near an outside steam supply, by using the blower to create a draft and holding a lighted torch to all seams and joints.
>
> In superheater locomotives with outside steam pipes, leaks are frequently found under the covering of the steam pipe where it goes through the sheet. When so located, the leak does not show a burnt spot.
>
> Any front-end leakage obviously increases the amount of gas and air which must be moved by the exhaust jet, and consequently necessitates a reduction in the size in the nozzle tip. This of course increases the cylinder back pressure and entails fuel losses; and in addition frequently leads to partial engine failures and to an increased cost of front-end maintenance.
>
> Every motive power official and employee who is responsible for the maintenance of locomotives should see to it that front-ends on locomotives are tested for air leaks at frequent intervals.

Circulars Nos. 9 and 10, addressed to the men in engine service, are practically the same, and read as follows:

> Our government today is spending not millions, but billions of dollars for labor and supplies, for arms and ammunition, and for ships to move men and material.
>
> We are in this war to win. We shall have to pay for winning, as we always pay for anything worth while. This is not the President's job; it is not Secretary Baker's job, nor Secretary Daniels' job, nor Director General McAdoo's job. *It is our job.*
>
> With this point settled and everybody agreed, what remains for you and me to do? *The answer is to work and to save.* Why? Because nothing but labor and material will do the business. Money will not do it. It cannot be worn nor used for food; like the steam gage on the boiler, it is something to show pressure—but the steam gage never pulled a car. Human labor, human intelligence, and what they create are the vital things. Food and clothing, rifles and machine guns, shells and ships, all spring from these.
>
> *We shall win the war by the material we produce and by the way we use it.* We must get the most out of it, whether it be fuel, munitions or food. In the case of railroad fuel, we must make every ton move its maximum of men and material. You all know the ways in which this can be accomplished. This section is getting out a little handbook, containing suggestions of how to save railroad fuel. It will reach you within a few days. There is nothing new-fangled about it. You have all heard for years the suggestions it contains; but if every man would observe these suggestions in his daily work, we should save an enormous amount of coal.
>
> We urge you to make a showing, but you must have the opportunity. Here it is—and as fine a chance as any man could wish for. This is the railroad bill for bituminous coal before and since the war.

| Year | Period | Tons | Cost per ton | Value at mines |
|---|---|---|---|---|
| 1915 | —Before the war | 122,000,000 | $1.13 | $137,860,000 |
| 1917 | —First year of the war | 155,000,000 | 2.13 | 330,150,000 |
| 1918 | —Second year of the war | 166,000,000 | 2.50 | 415,000,000 |

These are the costs of the coal at the mines. During 1918 it will cost a dollar more per ton for company haul and handling; and for the 48,000,000 barrels of fuel oil which the railroads will use this year, they will pay $69,000,000. *This will make the railroad fuel bill for this year* $650,000,000, excluding the cost of anthracite.

Here are reasonable estimates of the savings which will result from even a moderate amount of extra effort and attention:

| | |
|---|---|
| 1 per cent saving represents | $6,500,000 |
| 2 per cent saving represents | 13,000,000 |
| 4 per cent saving represents | 26,000,000 |

We present these facts to you in terms of dollars because the size of the job is most readily understood in such terms. *Remember, however, that it is not dollars we are interested in, but coal.* Coal sells for a fixed price per ton, but nobody can say today how much it is really worth. Coal enough in the next twelve months may well make the difference between winning or losing the war.

A coal shortage looms up ahead. It is estimated at about 75,000,000 tons. The shortage last year was 60,000,000 tons. There are only three ways in which to make this good:

First—By providing cleaner coal.

Second—By shutting off the so-called non-essential industries.

Third—By conserving by every possible means the coal which we must use.

The coal miners are going to do their share by giving us cleaner coal. They have been appealed to, and they are responding.

Scores of so-called non-essential industries have already curtailed their output; to go further in this direction will mean unemployment and disaster for your friends and neighbors. There is not much more to be had along this route.

The shortage must be made good chiefly by *care in the use of food.* The railroads use nearly one-third of all fuel produced in the country, and a large share of the responsibility consequently rests on us. The Railroad Administration has given and will continue to give special attention to the improvement of the condition of power. The rest is up to us.

The miner will save his 2 per cent by giving us cleaner coal. The improved condition of power will contribute as much more. We railroad men who use the coal should contribute our 2 per cent. We may well do much more. Let us all pull together for a saving of 10,000,000 or perhaps 20,000,000 tons. We can make it if everyone puts his shoulder to the wheel.

I we win in this attempt, we shall have contributed to the successful outcome of the war; we shall have safeguarded ourselves, and our friends and neighbors from discomfort and unemployment; and we shall have added to our own skill and increased our own satisfaction and self-respect. *We shall have lined up solidly behind the first line "over there."*

### FUEL LOSSES CAUSED BY HOSTLERS

A communication relative to the fuel losses caused by hostlers not handling to the best advantage the movements of engines to and from the passenger stations was sent to the regional directors. In this letter the manager of the fuel conservation section said:

"My attention has been directed to the fact that a great many terminal locomotives are delivered to the crews at the passenger stations by hostlers; in a similar manner the crew on arrival abandon the engines in the passenger stations, hostlers moving same to roundhouse.

"In many instances the engines are fired up so as to conform to the schedule established by the hostler and his helper, enabling him perhaps to move all passenger engines during a certain pre-determined period. In a similar manner engines are allowed to stand at passenger stations, in some instances for several hours, waiting for the hostler to remove same to the roundhouse, this situation representing a very material fuel loss.

"Will you ask the several federal managers to make a canvass of this situation, attempting to organize the stand-by time of passenger locomotives moved by hostlers from and to passenger stations to the end that such be reduced as much as possible."

### FUEL ECONOMY DISCUSSED AT THE PITTSBURGH RAILWAY CLUB.

H. C. Woodbridge, supervisor for the Allegheny Region, read a paper before the Pittsburgh Railway Club, in which he mentioned the various methods by which all railroad men can assist in saving fuel. In a message to master mechanics, traveling engineers and roundhouse men the following points were strongly emphasized:

Find out how much coal you are using in banking and building fires and how much you can reduce this amount. Try banking the fires on the front of the grates only, using wet coal.

Avoid as much as possible the waste of coal which falls through grates when preparations are being made to fire up.

Stop unnecessary blower line losses and other leaks.

Cover steam pipes in roundhouses and shops and on your locomotives with suitable lagging.

Stop leaks in your stationary boiler settings and arches. Use dampers and have the flue gases analyzed.

Stop air leaks into smokeboxes.

Provide sufficient air opening in ashpan — at least 14 per cent of grate area.

Don't overload tenders, and keep the unused coal shoveled ahead. It spoils on the back of tank, injures the sheets and is just that much useless load to drag around.

Correct improper steam distribution. A lame engine in this country is the Kaiser's delight.

Report poor coal, giving enough information so that the mine at which it was loaded can be located and properly dealt with.

Determine the proper size and character of nozzle tip for various classes of engines, and keep a record of nozzle sizes; make frequent checks to correct errors in draft appliances. Don't monkey with nozzle tips; correct defects which cause steam failures.

Use scrap wood for fuel when practicable.

Record condition of fires in incoming engines and advise the road foreman or instructors when improper firing is evident so that the inexperienced man will be instructed as soon as possible.

If consistent don't clean fires on incoming engines which will go out soon. Clean these fires when engine is taken out. The ashes will help keep the pops down and at the same time protect the flues while engine stands at your terminal.

On the Chicago & North Western a test made last winter when the temperature was below freezing showed that an engine having its stack covered after the fire had been knocked out and the grates covered with green coal would stand from 8 p. m. Saturday until 2 a. m. Monday morning and have 20 lb. of steam on boiler at 2 a. m. Monday morning.

Repair steam heat regulators and piping before cold weather sets in.

Keep boilers clean of soot clinkers in flues and mud and scale inside. Mr. Foque, of the Soo Line, stated that in a bad water district of that road $163,000 in fuel alone was saved in one year by properly cleaning locomotive boilers.

Do the work for which you are best fitted and delegate office work and the investigation of non-essentials, post-mortems, etc., to others.

Get a counter and compare the number of scoops of coal used by various crews in similar service between given points and let the men know the results.

Instruct new men.

Have your instructors spend some time with fire cleaners and builders, as well as with the roadmen.

Supervise systematically the preparation of fires before starting, as well as fires in incoming engines.

You know the thousand things to do. Hit the most important things first and hardest. Do your full duty more thoroughly than ever before.

---

SUBSTITUTES FOR GREASE.—Owing to the scarcity of grease in Germany, engineers in that country are paying much attention to other forms of lubricating material. Der Papier-Fabricant says that from 40 to 60 per cent of tallow mixed with mineral oil is effective and economical, and that high-grade graphite may be substituted for the tallow. Artificial graphite is manufactured in Germany both by intensive chemical treatment and by subjecting carbonaceous material to the heat of an electric arc in a space from which air has been excluded.

# THE TIME LOST IN SLOWDOWNS

### A Method of the Application of the Principles of Acceleration Illustrated by a Typical Example

BY WALTER V. TURNER, Eng. D.,
Manager of Engineering, Westinghouse Air Brake Company

WITH a train in steam road service, the maximum possible rate of change of velocity is considerably greater during the period of deceleration than during the period of acceleration. That it should be so, is quite evident from the fact that the accelerating force is secured from the engine alone and thus is limited by the weight on the drivers times the coefficient of adhesion between the driver wheels and the rail; while the decelerating force is obtained on the engine and every car in the train, and consequently is only limited by the weight of the whole train times the coefficient of adhesion between the wheels and the rail.

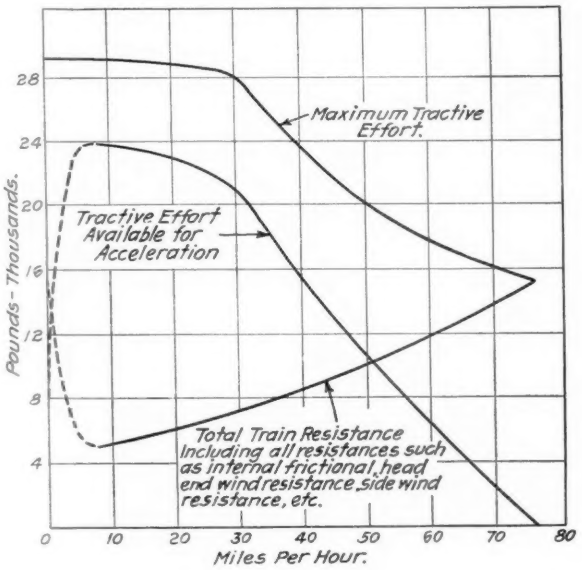



Fig. 1—Train Resistance and Tractive Effort Curves

The object of this paper is to compare acceleration with deceleration in steam road service, to compute the time lost by a slowdown, and to show how these determinations may be made theoretically. For clarity, the following specific case will be used: a Pacific type locomotive with 10 Pullman cars, decelerating from 70 to 30 miles per hour, under braking conditions mentioned later, then running at 30 miles per hour for a distance of 13,825 ft. and finally accelerating at the maximum rate possible with the given train and locomotive from 30 to 70 miles per hour.

The data are the following—one Pacific type locomotive, weight on drivers 173,000 lb., weight on front truck 50,000 lb., weight on back truck 50,000 lb., weight of tender, loaded, 133,200 lb., and weight of tender, empty, 66,700 lb.; drivers 79 in. in diameter, cylinders 22 in. in diameter by 28 in. stroke; 200 lb. steam pressure; evaporative heating surface 3791.3 sq. ft.; superheating surface 723.8 sq. ft. The rate of evaporation is assumed to be 10 lb. of water per hour per square foot of equivalent heating surface. The total weight of the cars is 1,567,000 lb. and all are equipped with the "PC" brake equipment. A brake pipe pressure of 110 lb. is carried and a total brake pipe reduction of 12 lb. is used to decelerate the train from 70 to 30 miles per hour. The braking ratios are as follows:—Of drivers .60; of trailers and front truck .45; of light weight of tender 1.1 with 50 lb. cylinder pressure; of cars .90 with 86 lb. cylinder pressure.

The first step will be to find the velocity-distance and time-distance relations when the train is accelerated at the maximum rate possible under the given conditions. To do this, the tractive effort available for acceleration must be found. Since this factor depends upon the train resistance and the tractive effort actually developed between the drivers and the rail, these latter items must first be computed.

The limit of the tractive effort developed at the rail is, the weight on the drivers multiplied by the coefficient of adhesion between the driver wheels and the rails. Since this value is not constant, due to the variation in the condition of the rail, the locomotive is designed to develop a tractive effort within a safe margin of the minimum probable limit. Otherwise, the driver wheels would slip, accompanied by all the attendant difficulties.

While the above enumerated factors determine how much tractive effort may be obtained, how much is actually secured depends upon the size of the boiler, dimensions of the fire-box, size of steam chests, etc. The tractive effort obtainable depends upon the following quantities:

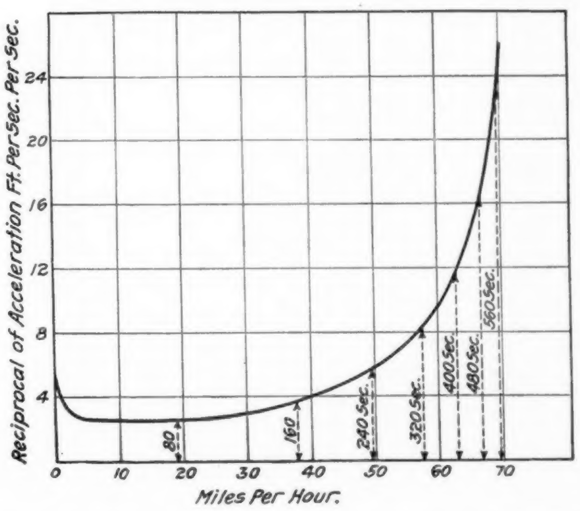



Fig. 2—Time Required to Accelerate to Various Speeds

TF = The total tractive effort developed by the cylinders in pounds.
H = The entire heating surface of the boiler in sq. ft. (For superheater locomotives multiply the superheater surface by 1.5, and add it to the other heating surfaces.)
$P_c$ = The initial (gage) cylinder pressure in lb. per sq. in. (taken as 10 lb. lower than boiler pressure).
$P_b$ = Boiler pressure, pounds per sq. in. (gage).
E = The pounds of water actually evaporated per hour per sq. ft. of equivalent heating surface.
W = The weight of one cubic foot of steam at the initial cylinder pressure and temperature in pounds.
S = The speed of the train in miles per hour.
$C = \frac{d^2l}{D}$
d = Internal diameter of steam cylinder in inches.
l = Stroke of the piston in inches.
D = The diameter of the driver wheels in inches.

If the transmission of steam from the boiler to the steam chest, etc., were accomplished without any losses, then

$$TF = \frac{P_b d^2 l}{D}$$

Inasmuch as the transmission is not perfect, but only about 85 per cent so,

$$TF = \frac{.85\ P_b d^2 l}{D}$$

This equation holds true, with slight variation, as long as the space displaced by the pistons in a unit time does not exceed the volume of steam, at full boiler pressure, generated in the same time; and, of course, with the valve gear adjusted to permit steam to enter the cylinders at the maximum cut-off. On this basis, the tractive effort developed at slow speeds is equal to:

$$\frac{.85\ P_b d^2 l}{D} = \frac{.85 \times 200 \times 22 \times 28}{79} = 29{,}150 \text{ lb.}$$

Next, the train speed at which steam is supplied to the cylinders at as fast a rate as it can be generated, must be determined. Whence:

W = The weight of one cubic foot of steam at the initial cylinder pressure and temperature, in lb. (from Marks' and Davis' Steam Tables for 190 lb. gage pressure and 200 deg. F. superheat) $= \frac{1}{2.97} = .337$

$$\frac{HE}{W} = \frac{(3791 + 724 \times 1.5) \times 10}{.337} = 145{,}000$$ cu. ft. of steam, at 190 lb. gage pressure and 200 deg. F. superheat, generated per hour.

$$\frac{4\pi d^2 l}{4 \times 1728} = \frac{4 \times 3.1416 \times 22^2 \times 28}{4 \times 1728} = 24.6$$ cu. ft. of space displaced by the locomotive pistons per revolution of the driver wheels.

Hence:

$$\frac{145{,}000}{24.6} = 5900 \text{ revolutions of the drivers per hour.}$$

Therefore:

$$\frac{\pi D \times \text{rev. drivers per hr.}}{12 \times 5280} = \frac{79 \times 3.1416 \times 5900}{12 \times 5280} = 23.1 \text{ mi. per hour}$$

Beyond this speed steam cannot be generated at a sufficiently fast rate to fill the space displaced by the pistons, at substantially full boiler pressure. For this reason, the cut-off must be decreased and hence the maximum obtainable tractive effort will of necessity be decreased with an increase in speed.

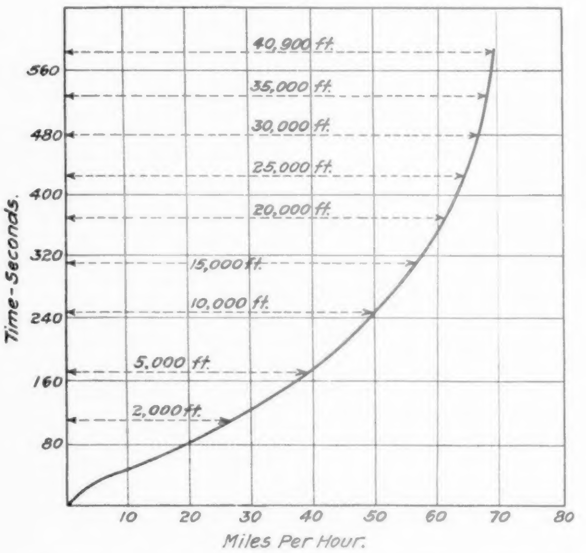



Fig. 3—Time and Distance Required to Reach a Given Speed

The values derived from the following formula* take care of this condition:

$$TF = \frac{2P_e\,C}{\dfrac{110\ CSW}{3EH} + 1}$$

In applying it to the case under consideration:

$$P_e = 200 - 10 = 190$$

$$C = \frac{22^2 \times 28}{79} = 171.2$$

$$H = 3791 + 1.5 \times 724 = 4877$$

$$E = 10$$

Therefore:

$$TF = \frac{2 \times 190 \times 171.2}{\dfrac{110 \times .337 \times 171.2 \times S}{3 \times 10 \times 4877} + 1} = \frac{65200}{.0435S + 1}$$

Consequently:

| S | T. F. |
|---|---|
| 30 | 28,200 |
| 40 | 23,800 |
| 50 | 20,500 |
| 60 | 18,100 |
| 70 | 16,100 |

The values given above are plotted in Fig. 1 as maximum tractive effort. It should be understood that this is the maximum tractive effort possible to obtain from the locomotive under the given conditions. It would, of course, be difficult for the engineer to manipulate his valve gear so precisely as to reproduce exactly these curves; but nevertheless, since the determination of the maximum possible conditions is the intention, this consideration of operation will be neglected.

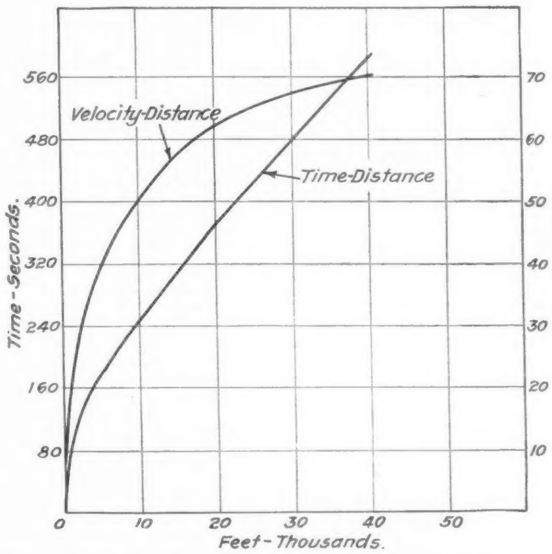



Fig. 4—Time-Distance and Velocity-Distance Curves for Acceleration

The total tractive effort developed, however, is not entirely available for acceleration, for part of it is required to overcome the train resistance. Train resistance consists of journal friction, rolling friction, head-end, rear-end and side wind resistance, grade and curve resistance, etc. The formula for train resistance, with the following notation, is:

R = Total train resistance in lb.
N = Number of cars (locomotive with its tender is considered the equivalent of three cars).
T = Total weight of train in tons.
V = Velocity of train in miles per hour.
K = Curvature in degrees.
G = Grade in per cent.
B = Number of pairs of drivers.
Z = Weight on drivers in tons.

$$R = 100\,N + (1.5 + K + 20\,G)T + .01\,V(V + 16)\sqrt{TN} + [22 + .15(B-1)\,V]\,Z + .1\,V^2$$

In this specific case:

$N = 10 + 3 = 13$
$K = 0$
$G = 0$

| | | |
|---|---|---|
| T = | 173,000 lb. | Weight on drivers. |
| | 50,000 lb. | Weight on front locomotive truck. |
| | 50,000 lb. | Weight on back locomotive truck. |
| | 66,700 lb. | Weight of tender (empty). |
| | 33,250 lb. | Weight of half load in tender. |
| | 372,950 lb. | Weight of engine and tender. |
| | 1,567,000 lb. | Weight of cars. |
| | 1,939,950 lb. | Total weight of train. |

*This is known as the Kiesel tractive effort formula. For its derivation see the *Railway Mechanical Engineer*, for December, 1916, page 627.

1,939,950 lb. ÷ 2000 = 970 tons.

$$B = 3\sqrt{TN} = \sqrt{970 \times 13} = 112.3$$

$$Z = \frac{173{,}000}{2000} = 86.5$$

Whence:

$$R = 100 \times 13 + (1.5 \times 975) + .01\,V(V + 16)\,112.3 + [22 + .15(3 - 1)\,V]86.5 + .1\,V^2$$

Therefore:

$$R = 4663 + 44V + 1.23\,V^2$$

The total train resistance for various speeds is given below:

| V | R (Total) |
|---|---|
| 10 | 5,226 |
| 20 | 6,035 |
| 30 | 7,090 |
| 40 | 8,393 |
| 50 | 9,943 |
| 60 | 11,733 |
| 70 | 13,773 |

These values of resistance are plotted under the caption "Total Train Resistance" in Fig. 1. This formula, however, does not provide for the total train resistance between 0 and 5 miles per hour. When the train is set in motion, all its frictional resistance, being functions of the static coefficient of friction, are of greater magnitude than at somewhat higher speeds. As the velocity of the train increases, the coefficient of friction decreases so that from 5 to 10 miles per hour the total train resistance attains its minimum value, which is ¼ (approximately) its magnitude at 0 miles per hour. From this fact, the train resistance between 0 and 5 miles per hour is plotted as shown by the dotted line in Fig. 1. With a further increment in speed, (from 5 m. p. h.) the total resistance increases, because the rolling friction, machinery friction of the locomotive and the wind resistance are increasing functions of the speed, as is apparent from the above calculations and the curve in Fig. 1.

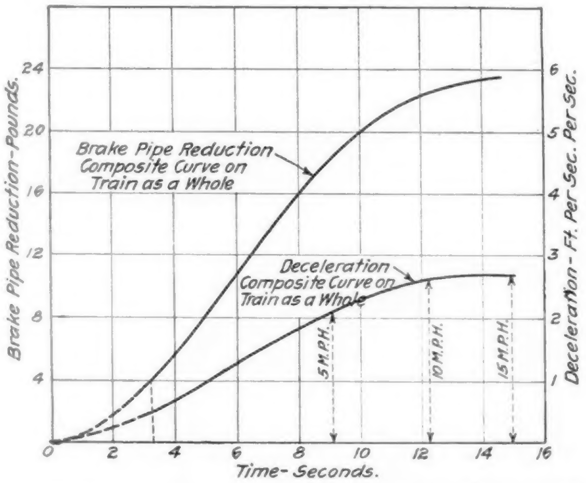



**Fig. 5—Composite Curves of Brake Pipe Reduction and Deceleration**

The previous determinations now make it possible to calculate the tractive effort available for accelaration. These values are represented by the middle curve in Fig. 1, which is obtained by subtracting the ordinates of total resistance from the ordinates of maximum obtainable tractive effort. As is apparent from the character of the other two curves on this figure, this value is comparatively high between 5 and 20 odd miles per hour and then continues to drop until it is 0 at 75 miles per hour. In other words, at 75 miles per hour, the maximum obtainable tractive effort equals the total train resistance, so that on a level tangent, the highest obtainable speed for this given train and engine is 75 miles per hour.

Inasmuch as the ultimate purposes of this calculation is to ascertain the time-distance and velocity-distance relations during acceleration, two intermediate steps are required to realize this objective. The first step is to find the relation between velocity and time. Now, the time to change from one velocity to another equals:

$$\int_{V_1}^{V_2} \frac{1}{A}\,\delta V$$

From this equation, it can be seen that if velocity is plotted as one scale and reciprocal of acceleration as the other, the area included between the curve and the velocity axis is proportional to the time required to change from one velocity to another. For the purpose of making such a graph, the reciprocal of acceleration for various velocities must be found. The reciprocal of acceleration from Newton's second law of motion, where:

F = Tractive effort available for acceleration,
T = Total weight of train in pounds.
g = Acceleration of gravity, viz., 32.16 ft. per second per second.
A = Acceleration of the train in ft. per second per second.

is given by the equation—

$$F = \frac{T}{g} A$$

Hence, the reciprocal of acceleration,

$$\frac{1}{A} = \frac{T}{Fg}$$

Now:

$$\frac{T}{g} = \frac{1{,}939{,}950}{32.16} = 60{,}500$$

(The rotative inertia of the wheels is so small that it has little effect and is neglected in this calculation.)

In the following table various values of $\frac{I}{A}$ are given, using the values of $F$ for the various velocities as shown in Fig. 1:

| V | F (= T.F. — R) | $\frac{T}{g}$ | $\frac{1}{A}$ |
|---|---|---|---|
| 0 | 9,000 | 60,500 | 6.74 |
| 2 | 19,200 | 60,500 | 3.15 |
| 5 | 23,400 | 60,500 | 2.59 |
| 10 | 23,874 | 60,500 | 2.54 |
| 20 | 22,865 | 60,500 | 2.65 |
| 30 | 21,110 | 60,500 | 2.87 |
| 40 | 15,407 | 60,500 | 3.92 |
| 50 | 10,557 | 60,500 | 5.74 |
| 60 | 6.367 | 60,500 | 9.53 |
| 70 | 2,327 | 60,500 | 26.0 |

The reciprocal of acceleration thus found, is plotted against the velocity of the train in Fig. 2. Consequently, as explained above, the area between this curve and the miles per hour axis is proportional to the time to change from one velocity to the other. Thus, 80 sec. are required to accelerate the train, at its maximum possible rate under the given conditions, from rest to 19 m. p. h.; 160 sec. from rest to 38 m. p. h.; 240 sec. from rest to 49½ m. p. h., etc.

These determinations in Fig. 2 now make it possible to plot speed against time as shown in Fig. 3. The advantage of such a graph is seen from the relation that

$$\int_{S_2}^{S_1} \delta S = \int_{T_1}^{T_2} V\,\delta T$$

whereby the area between the curve and the time base is proportional to the distance traversed. Thus, to cover 2,000 ft. from rest, with the train accelerating at its maximum possible rate, requires 110 sec. at which time a velocity of 27½ m. p. h. is attained; to cover 5,000 ft. 170 sec. are required, at which time a speed of 39½ m. p. h. is developed, etc.

From these values, the time-distance and velocity-distance curve may be plotted as in Fig. 4. This figure thus gives the relations desired in regard to the acceleration of the train and will be combined in a later curve with corresponding values for the deceleration of the train.

Now, the next procedure is to adopt a process somewhat

similar to the foregoing for determining the retarding action of the brakes on the train. In all brake equipments in which the brake action is produced by purely pneumatic means, air is vented from the end of the brake pipe on the engine through the brake valve. This reduction in brake pipe pressure naturally affects the valve on the head car first and

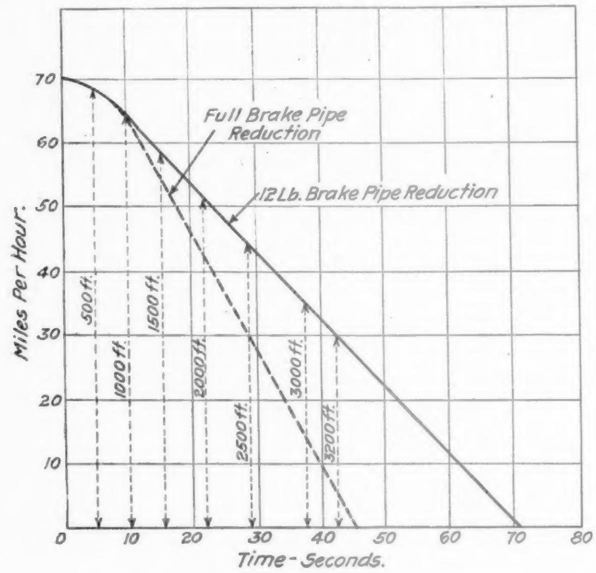



**Fig. 6—Velocity-Time Curve for Deceleration**

on each car in succeeding order thereafter. Hence, the brakes apply serially and until the brake pipe reduction is completed the brake pipe pressure is different on every car. For purposes of calculation, however, it is advantageous to consider the average brake pipe reduction throughout the train for each given period of time. These values, when

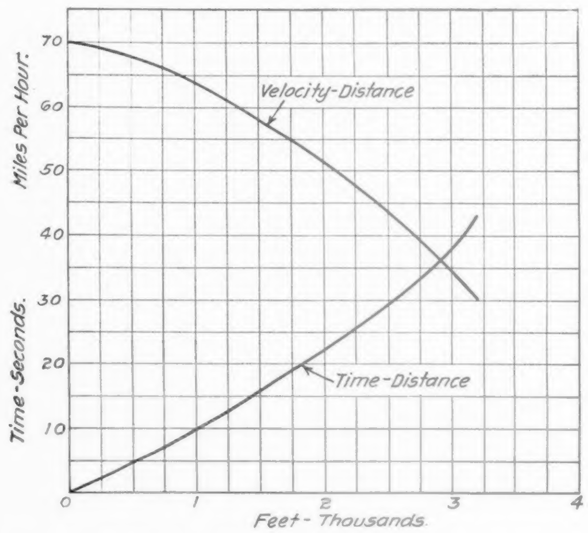



**Fig. 7—Time-Distance and Velocity-Distance Curves for Deceleration**

plotted, are called a "composite" curve and are shown on Fig. 5. The composite curve has been determined from test values.

For each brake pipe reduction, a corresponding brake cylinder pressure is developed; and this brake cylinder pressure, in turn produces a given brake shoe pressure from which a particular deceleration is realized. From the composite brake pipe reduction curve on Fig. 5, the composite curve for the deceleration of the train as a whole is determined as follows:

Braking ratio per lb. cylinder pressure $= \frac{.60}{50} = .012$ for the drivers.

Braking ratio per lb. cylinder pressure $= \frac{.45}{50} = .009$ for the front truck.

Braking ratio per lb. cylinder pressure $= \frac{.45}{50} = .009$ for the back truck.

Braking ratio per lb. cylinder pressure $= \frac{.734}{50} = .0147$ for the half-loaded tender.

Since a 1-lb. brake pipe reduction is approximately equal to a 2.5-lb. brake cylinder pressure, with the E. T. equipment:

Braking ratio per lb. brake pipe reduction $= .012 \times 2.5 = .03$ for the drivers.
Braking ratio per lb. brake pipe reduction $= .009 \times 2.5 = .0225$ for the front truck.
Braking ratio per lb. brake pipe reduction $= .009 \times 2.5 = .0225$ for the back truck.
Braking ratio per lb. brake pipe reduction $= .0147 \times 2.5 = .0368$ for the half loaded tender.

Braking ratio per lb. brake pipe reduction $= \frac{.9}{24} = .0375$ for the cars.

$$\frac{173{,}000 \times .03 + 50{,}000 \times .0225 + 50{,}000 \times .0225 + 99{,}950 \times .0368 +}{1{,}939{,}950}$$

$$\frac{1{,}567{,}000 \times .0375}{1{,}939{,}950} = .0360 \text{ brake ratio per lb. brake pipe reduction.}$$

Where:

$d'$ = the deceleration of the train in ft. per second per second.
$B'$ = the braking ratio, i. e., the total pressure that the brake shoes would exert against the wheels of the train, if the brake rigging were 100 per cent efficient, divided by the weight of the train.
$e'$ = the efficiency of the brake rigging.
$f'$ = the mean coefficient of friction between the shoe and wheel.
$g$ = the acceleration of gravity in feet per second per second.
$F'$ = force developed by the brake shoes in decelerating the train.
$T$ = weight of the train in pounds.

Then—

$$F' = \frac{T}{g} \times d'$$

also—

$$F' = B' \, T \, e' \, f'$$

therefore—

$$\frac{T}{g} d' = B' \, T \, e' \, f'$$

or

$$d' = B' \, e' \, f' \, g$$

Since the braking ratio per pound of brake pipe reduction=.0360, $e'$ $f'$=.1 and g=32.16, the deceleration of the train per pound brake pipe reduction equals $.0360 \times 32.16 \times .1 = .115$ ft. per second per second.

By multiplying this factor with the value of the composite brake pipe reduction for each given time, a composite deceleration curve may be produced as shown in Fig. 5.

Since, as in the case of acceleration, the object of this procedure is to determine the time required to make various changes in the velocity; this relation can be found by the area between the deceleration curve on Fig. 5 and the time axis, because

$$\int_{V_1}^{V_2} \delta V = \int_{T_1}^{T_2} A \delta T$$

Thus, it is found that the train speed reduces 5 m. p. h. in about 9.1 sec.; 10 m. p. h. in 12.2 sec., etc.

From the values obtained in this figure, time is plotted against velocity as indicated by the dotted line in Fig. 6. The dotted line is for a full brake pipe reduction, i. e., that reduction in brake pipe pressure which will produce the maximum possible brake shoe pressure for a service brake application. The bend in the upper portion is due to the variation in deceleration while the brakes are in the process of applying. After a full brake application is developed, the deceleration becomes substantially constant and the curve then closely follows a straight line.

In the instance under consideration, however, a 12 lb. brake pipe reduction was made. Consequently, a tangent which represents this deceleration must be drawn to the dotted line. Hence, after the brake application is initiated,

the deceleration increases until the 12-lb. value is reached, whereupon, the braking forces remain substantially constant until the brake is released.

Since the relation—

$$\int_{S_1}^{S_2} \delta S = \int_{T_1}^{T_2} V\delta T$$

obtains, as in several previous instances, the area beneath this curve is proportional to the distance traversed, i. e., in the first 5 sec., 500 ft. are passed; in a little over 9 sec., 1000 ft., etc. From these figures, the time-distance and velocity-distance curves are plotted in Fig. 7.

As stated at the outset, the object of this article is to compare acceleration with deceleration and to compute the time lost by a slow-down. This relation is now shown on Fig. 8. The values of deceleration are obtained from Fig. 7, and of acceleration from Fig. 4. The upper curve indicates that a 12-lb. brake pipe reduction reduces the speed of the train from 70 to 30 m. p. h. in a distance of 3200 ft. Then the train runs at a constant speed of 30 m. p. h. for 13,825 ft., and finally accelerates at its maximum rate, possible under the given conditions, from 30 to 70 m. p. h. in a distance of 38,500 ft. It should be borne in mind that under these conditions a locomotive is accelerating at its maximum

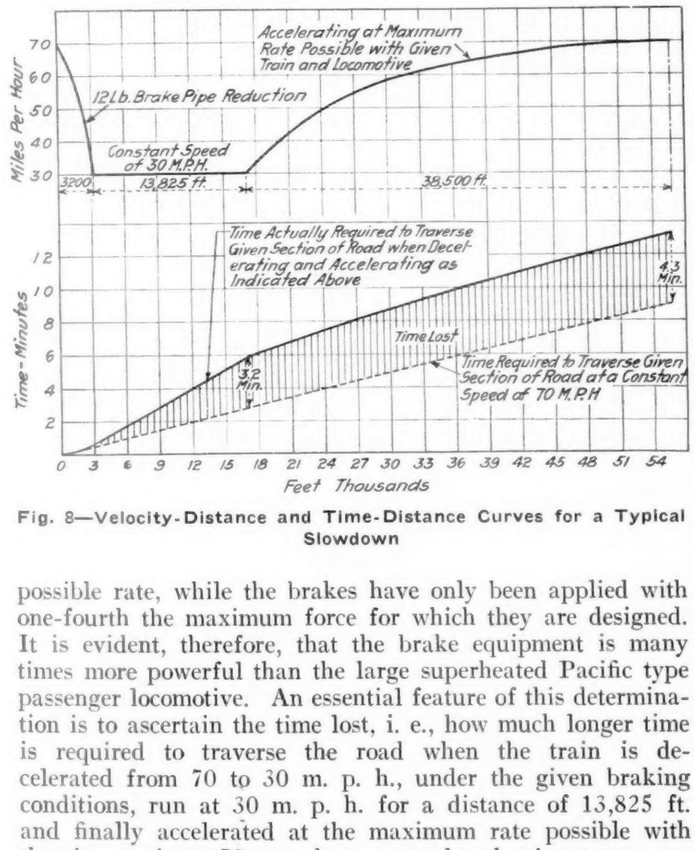



Fig. 8—Velocity-Distance and Time-Distance Curves for a Typical Slowdown

possible rate, while the brakes have only been applied with one-fourth the maximum force for which they are designed. It is evident, therefore, that the brake equipment is many times more powerful than the large superheated Pacific type passenger locomotive. An essential feature of this determination is to ascertain the time lost, i. e., how much longer time is required to traverse the road when the train is decelerated from 70 to 30 m. p. h., under the given braking conditions, run at 30 m. p. h. for a distance of 13,825 ft. and finally accelerated at the maximum rate possible with the given train, to 70 m. p. h., compared to the time to traverse the same section of road at the rate of 70 m. p. h. The dotted line in Fig. 8 represents the time to cover the given section of the road at a constant speed of 70 m. p. h. which may be plotted from the simple relation that a body moving at the rate of 70 m. p. h. covers 102.7 ft. every second. The heavy, solid line, directly above the dotted line, represents the time actually required to traverse the given section of road when the train is decelerated and accelerated, as indicated in the upper portion of Fig. 8. The time curve during the deceleration period can be determined by the values on Fig. 7, during the period the train is running at a constant speed of 30 m. p. h. from the relation that at a speed of 30 m. p. h. 44 ft. are covered every second; and during the acceleration period by the values in Fig. 4. Thus, it is found that at the end of the whole period, 4.3 min. are lost.

*The importance of considering slow-downs should be realized from the fact that 30 slow-downs, as the above, while seemingly of little moment, delay a train (4.3×30)= 129 min. or approximately 2¼ hours.*

The foregoing calculations are theoretical, and although an attempt to check the above by practical test may result in values slightly varying from these figures, due to differences in the condition of the equipment, methods of manipulation, errors in observations, etc., nevertheless, with care and equipment in good condition, results very close to the calculations should be obtained. In fact, these figures have been found to agree with service conditions on one of the large railroads of this country.

This example should make it apparent that the slowing down of a steam railway train for only a comparatively short distance, causes an appreciable loss in time. In fact, the loss in time, resulting from slow-downs, is one of the reasons why passenger trains are often routed around cities, where stops are not scheduled, rather than have them subjected to the time delaying ordinances necessary for safety within the city limits. Stops or slow-downs, when frequent, very materially reduce the scheduled speed of a train; and should be given careful consideration with the object of minimizing the effects, wherever they occur, because loss in time alone has a direct bearing in reducing the earning capacity of a road.

## FOURTH LIBERTY LOAN APPEAL

"We have the Kaiser groggy—let us keep hitting hard now until he is counted out," says Director General McAdoo in his appeal for Liberty Loan subscriptions by railway employees in the coming loan campaign. He says that he wants every railroad man to go the limit in lending his available means to Uncle Sam. He suggests that they begin to save now, and says that no employee can make better use of the back pay recently awarded him than by putting it in Liberty Bonds. The appeal is given in Circular No. 51, the distribution of which to employees was begun recently. This circular follows:

"In order to raise sufficient money to arm, equip and support our gallant soldiers and sailors, to finance our other war activities, and to extend necessary credits to our Allies, to enable them to continue the war against the German military despotism, the Fourth Liberty Loan campaign will begin September 28, 1918. Every loyal American must invest in the securities of his government to the limit of his ability if America is to triumph in this war.

"Railroad men and women are doing a vital service for their country. They responded patriotically to the appeal of the government in the First, Second and Third Liberty Loan campaigns, and I hope that they have bought liberally of War Savings Stamps. They are also operating the railroads, which is war service of primary importance. I am sure that they count it a glorious privilege to do this vital work for their country. I deeply appreciate what they have already done, but there is more to do, and I am sure that they will do more if the way is pointed out to them.

"The enormous sums required to finance democracy's part in the war impose a new duty upon each and every one of us. Liberty Loans must be offered from time to time until the Kaiser is licked to a finish. Each of these loans must be subscribed in full. No patriotic American will have performed his duty by subscribing to one loan only, or by buying a few War Savings Stamps. Each and every one should practice every possible economy, save every possible dollar, and buy as many Liberty Bonds as he can afford every time a Liberty Loan is offered to the country.

"In the Fourth Liberty Loan campaign which is just ahead

of us I wish to make a special appeal to every railroad employee to go the limit in lending of his available means to Uncle Sam. Now is the time to prepare for that campaign by saving every possible dollar, so that each may be ready to do his part before the subscription closes. Hundreds of thousands of employees in the railroad service of the United States have received, or will receive, checks for back pay, in accordance with the provisions of the Wage Order I approved May 25, 1918, and Supplement No. 4 to General Order 27, issued on July 25, 1918. No employee can make better use of his back pay than to lend it to the government at interest, thus securing an investment of absolute safety for himself and building up a reserve for a rainy day.

"You must remember that you are not asked to *give* your savings to the government; you are asked merely to *lend* your money to your government—and for what purpose? To back the millions of the finest American boys ever collected together in a great army, and to help them fight irresistibly for our lives, liberties, and vital interests. One and a half million of these splendid boys are already in France, and already they have given the Kaiser a dose from which he is staggering and from which he will not recover. But the pressure must be kept up. Arms, ammunition, and food supplies of all kinds must go forward in a continuous stream if the pressure is to be maintained. It depends upon us who stay at home to keep the pressure applied. We must lend our money to our government, lend it to the limit, so that the government may in turn put in the hands of our splendid sons the things without which they can not fight and without which the defeat of the Kaiser and his hateful military despotism can not be accomplised.

"I want the railroad men and women of the United States to do more, if possible, then anybody else, because I want them to be among the first always in patriotism, in service, and in sacrifice to our great and glorious country. We have the Kaiser groggy—let us keep hitting hard now until he is counted out."

## RESULTS OF ROAD TESTS OF N. & W. MALLET LOCOMOTIVE

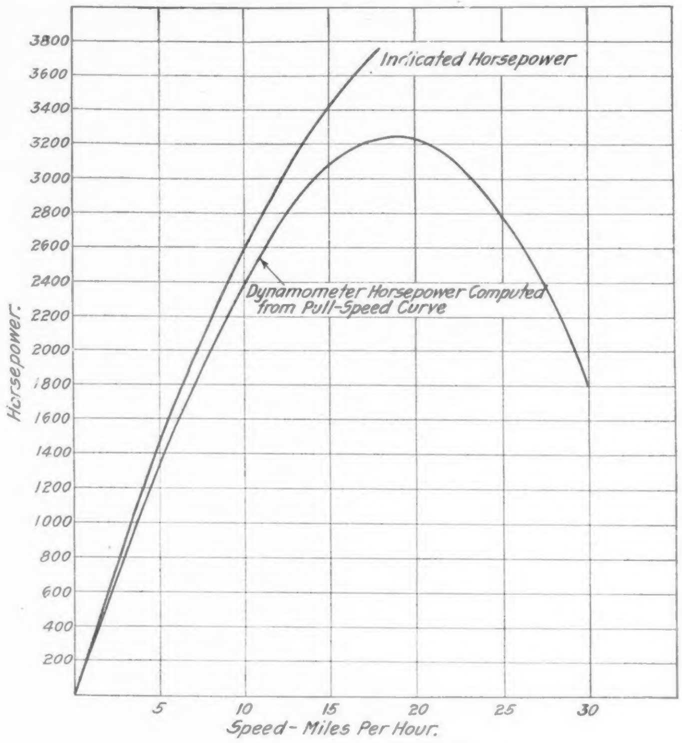
BY H. W. REYNOLDS

In the description of the Norfolk & Western 267-ton Mallet type locomotive, which appeared on page 445 of the August, 1918, issue of the *Railway Mechanical Engineer*, reference was made to the fact that the free steaming qualities of this locomotive had been demonstrated by road tests. The tests referred to were conducted with a dynamometer car in road service on the Pennsylvania Railroad, and data showing the performance of the locomotive during these tests is now available.

After making one trip in road service on the Norfolk & Western the engine was sent under its own steam to Altoona, Pa., and turned over to the Pennsylvania Railroad to be tested on the Pittsburgh division. No special adjustments whatever were made in anticipation of the tests, which were made with the locomotive in exactly the same condition in which it had been turned over to the transportation department for service.

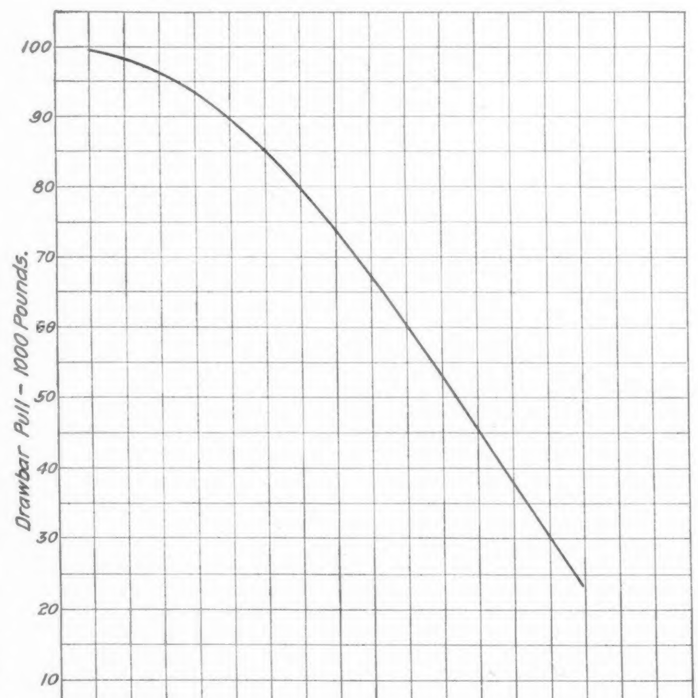
The tests were made on slow freight trains composed of cars of mixed classes and lading, the Mallet type locomotive coupled to the dynamometer car being placed ahead of a Pennsylvania Mikado type locomotive which in turn was coupled to the head of the train. The nominal speed of the test trains was 12 miles an hour, regulated by working the Mikado locomotive to suit grade conditions. The Mallet locomotive was operated at its maximum capacity on most of the tests over practically the entire run.

The distance from the starting to the stopping point of the test was about 22 miles. The difference in elevation between these two points was 885 feet, corresponding to an average ascending grade of .767 per cent. The ruling grade over which these tests were run was 1.15 per cent, four miles long.




Horsepower Curve for the N. & W. Mallet Locomotive

The figures given below for these tests are averages for the whole trip. They do not represent the maximum output of the boiler that would have been obtained for a shorter period of time or if conditions had been such that the locomotive could have been worked at its maximum



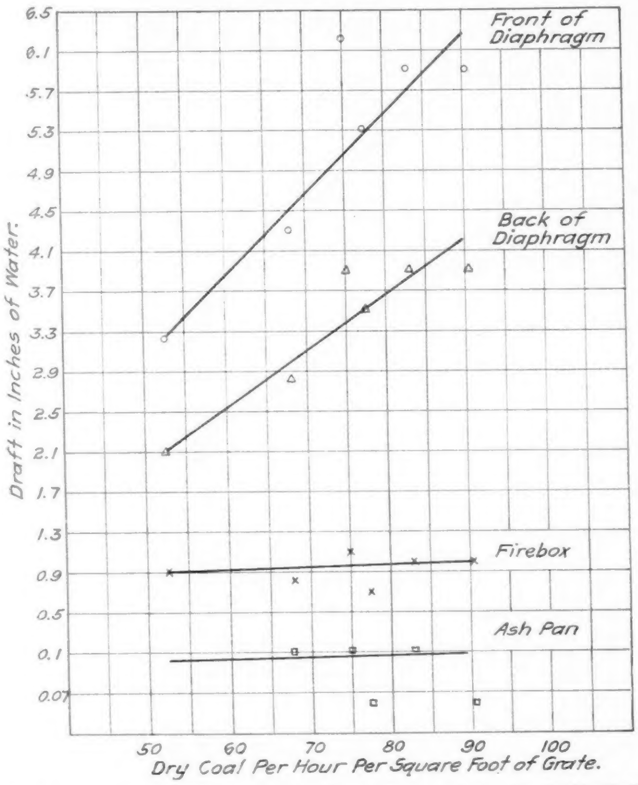

Drawbar Pull-Speed Curve of the N. & W. Mallet Locomotive

boiler capacity during the entire time it was actually running.

TABLE I—BOILER PERFORMANCE

| | Maximum | Minimum | Average for tests |
|---|---|---|---|
| Average steam pressure, lb. per sq. in. | 230 | 224 | 227 |
| Total dry coal fired, lb. per hr. | 8,679 | 5,053 | 7,140 |
| Dry coal fired, lb. per hr. per sq. ft. grate | 90.41 | 52.63 | 74.4 |
| Total equivalent evaporation, lb. per hr. | 68,006 | 44,787 | 56,720 |
| Equivalent evaporation, lb. per hr. per lb. dry coal | 8.86 | 7.08 | 8.01 |
| Equivalent evaporation, lb. per hr. per sq. ft. heating surface | 8.66 | 5.71 | 7.23 |
| Boiler horsepower | 1,971.2 | 1,298.2 | 1,644.0 |
| Efficiency of boiler, per cent | 66.41 | 46.47 | 55.0 |

The principal items of boiler and engine performance are given in Tables I and II, respectively. Data relative to the




**Draft Conditions Recorded in the Road Tests of the N. & W. Mallet Locomotive**

performance of the locomotive as a whole is given in Table III.

TABLE II—ENGINE PERFORMANCE

| | Maximum | Minimum | Average for tests |
|---|---|---|---|
| Speed, miles per hour | 12.03 | 8.16 | 10.5 |
| Average boiler pressure, lb. per sq. in. | 230 | 224 | 227 |
| Average h. p. engine steam chest pressure, lb. per sq. in. | 203 | 181 | 194 |
| Average h. p. engine superheat, deg. F. | 215 | 191 | 206 |
| Average h. p. engine indicated horsepower | 1,251 | 1,079.5 | 1,177.6 |
| Average l. p. engine steam chest pressure, lb. per sq. in. | 67 | 49 | 62 |
| Average l. p. engine superheat, deg. F. | 96 | 67 | 81 |
| Average l. p. engine indicated horsepower | 1,507.6 | 1,226.3 | 1,362.5 |
| Total indicated horsepower | 2,758.6 | 2,305.8 | 2,538.9 |
| Per cent of total work by l. p. cylinders | 54.65 | 52.85 | 53.6 |
| Steam lb. per i. hp. per hr. | 17.82 | 15.21 | 16.56 |

The back pressure in the cylinders for a range in steam consumption between 37,000 to 50,000 lb. per hour was 70 to 75 lb. in the high-pressure cylinders and from 4 to 6 lb. in the low-pressure cylinders.

TABLE III—PERFORMANCE OF THE LOCOMOTIVE AS A WHOLE

| | Maximum | Minimum | Average for tests |
|---|---|---|---|
| Average running speed, m. p. h. | 12.03 | 8.16 | 10.5 |
| Average draw-bar pull, lb. | 63,800 | 50,400 | 58,850 |
| Machine efficiency | 88.71 | 86.92 | 87.09 |
| Dry coal per i. hp. hr. | 3.15 | 2.83 | 2.98 |
| Steam, lb. per i. hp. hr. | 17.82 | 15.21 | 16.56 |
| Dry coal, lb. per d. hp. hr. | 3.89 | 3.19 | 3.52 |
| Steam, lb. per d. hp. hr. | 21.20 | 17.51 | 19.46 |

As the calculated tractive effort of the locomotive when working compound is 104,350 lb., the maximum draw-bar pull developed was greater than could be recorded by the dynamometer car, which had a capacity of 100,000 lb. The greatest recorded pull was 97,600 lb. which, when corrected for grade and acceleration, was 106,100 lb. at 1 m. p. h.

The draw-bar pull curve shown was obtained from instantaneous pulls taken from the dynamometer records, corrected for grade and acceleration. Over the ruling grade on one test the average draw-bar pull was 71,940 lb. at an average speed of 12 miles an hour. The corresponding pull on level tangent track would have been 80,540 lb. During this test the locomotive was worked in full gear with a wide-open throttle and an average steam pressure of 227 lb. On another test the average draw-bar pull exerted by the locomotive over the same grade was 73,600 lb., corresponding to a pull on level tangent track of 82,200 lb. The average speed on this test was 11.6 miles an hour, and an average steam pressure of 230 lb. was maintained.

Had it been possible to have recorded the maximum draw-bar pull with the engine working simple, the draw-bar pull curve would have gone considerably higher than shown, for the calculated simple tractive effort of the locomotive is 135,000 lb.

## M. K. & T. PULVERIZED COAL TESTS

In the October, 1916, issue of the *Railway Mechanical Engineer*, page 499, there appeared a description of the equipment installed at the power house of the Parsons shops of the Missouri, Kansas & Texas for the preparation and burning of pulverized coal. At that time some tests had been made on one of the boilers using several varieties of coal, and a brief summary of the results was included in the article. In June, 1917, another series of tests was conducted. A brief summary of the results of these tests is given in the tables:*

TABLE I—SUMMARY OF POWDERED COAL TESTS AT M. K. & T. SHOPS.

| Kind of fuel | Lignite, Texas | Cherokee slack, So. Kansas | Semi-Anthracite, Kansas |
|---|---|---|---|
| Duration of test, hours | 4.5 | 4.0 | 3.5 |
| Boiler pressure, gage lb. | 137.5 | 136.0 | 135.5 |
| Draft, inches water: | | | |
| At damper | 0.092 | 0.055 | 0.000 |
| Top third pass | 0.148 | 0.083 | 0.075 |
| Bottom second pass | 0.119 | 0.105 | 0.070 |
| Top first pass | 0.039 | 0.021 | 0.010 |
| Furnace | 0.082 | 0.051 | 0.038 |
| Furnace temperature, deg. F. | 2,352.0 | 2,329.0 | 2,408.0 |
| Stack temperature. deg. F. | 597.9 | 534.6 | 624.3 |
| Gas at end of flame: | | | |
| $CO_2$ | 16.67 | 15.1 | 16.5 |
| $O_2$ | 1.93 | 2.9 | 1.9 |
| CO | 0.24 | 0.1 | 0.0 |
| N | 81.16 | 81.9 | 81.6 |
| Gas at stack: | | | |
| $CO_2$ | 14.75 | 14.8 | 15.8 |
| $O_2$ | 5.05 | 3.5 | 3.0 |
| CO | ..... | ..... | ..... |
| N | 80.20 | 81.7 | 81.2 |
| Proximate analysis of coal: | | | |
| Moisture | 17.06 | 1.06 | 0.30 |
| Volatile, dry | 61.52 | 32.41 | 22.9 |
| Fixed C, dry | 24.72 | 49.57 | 59.94 |
| Ash, dry | 13.76 | 18.02 | 17.77 |
| Sulphur (separately determined) | 0.98 | 5.14 | 4.09 |
| B.t.u. per lb. as fired | 8,854.0 | 12,056.0 | 12,587.0 |
| B.t.u. per lb. dry coal | 10,675.0 | 12,185.0 | 12,625.0 |
| B.t.u. per lb. combustible | 12,378.0 | 14,863.0 | 15,352.0 |
| Size: | | | |
| Through 100-mesh sieve, per cent | 92.75 | 91.56 | 91.92 |
| Through 200-mesh sieve, per cent | 75.08 | 73.50 | 77.48 |
| Coal burned per hour, dry, lb. | 1,244.0 | 1,161.0 | 997.0 |
| Per cent ash and refuse in dry coal | 13.76 | 18.02 | 17.77 |
| Weight of combustible in ash | 0 | 0 | 0 |
| Water evaporated per hour, actual | 7,427.0 | 8,005.0 | 8,657.0 |
| Equiv. evap. per hr., lb. | 7,844.0 | 8,482.0 | 9,034.0 |
| Horsepower, builder's rating | 191.2 | 191.2 | 191.2 |
| Per cent of rated horsepower developed | 119.0 | 129.0 | 137.0 |
| Equiv. evap. per lb. coal as fired, lb. | 5.229 | 7.231 | 9.034 |
| Equiv. evap. per lb. dry coal, lb. | 6.305 | 7.306 | 9.061 |
| Equiv. evap. deg. per sq. ft. H.S. per hr., lb. | 4.102 | 4.436 | 4.725 |
| Per cent excess air per lb. dry coal, furnace | 11.99 | 16.97 | 11.69 |
| Per cent excess air per lb. dry coal, uptake | 26.89 | 19.88 | 16.08 |

*The data in the tables and the discussion of the tests are abstracted from an article by H. R. Collins and Joseph Harrington which appeared in the General Electric Review for October, 1917.

Three different fuels were tested having a considerable range in quality. The first test was of Texas lignite, which had been stored in the open air over six months, and sub-

jected to freezing and thawing, and the influence of the sun and wind all this time. It was not necessary to dry this lignite to the same degree that the other coals were dried, and the 17 per cent of moisture in the coal, as fired, did not affect its apparent quality at all. To all appearances, it was as fluid as the semi-anthracite coal containing only 0.3 per cent moisture. The second coal was a fairly high ash, high sulphur coal from southern Kansas, and is the coal which is usually burned at this plant. For the last test a car load of semi-anthracite screenings was obtained. This coal was very fine when received, and was stated to be of a kind which is unsalable on account of its size.

It was not possible under the conditions obtaining at the time to conduct tests even as long as eight hours, so that tests of shorter duration were made. While these tests may appear to be short as compared with the accepted practice in mechanical stoker testing, it must be remembered that the amount of fuel actually in the furnace at any one time, is represented by a very few pounds, and that when the feed screw is suddenly stopped, the combustion as suddenly ceases.

One point of particular interest is the heat balance, which indicates conditions unusual in boiler testing. The boilers themselves were O'Brien boilers, which had been rebaffled to provide three cross passes for the gases, and inability to clean the heating surface of these boilers by hand resulted in one-half of the heating surface being particularly dirty. To this may be ascribed much of the inefficiency of the boiler. Gas temperatures nearly 200 deg. F. in excess of what could properly be expected were obtained at the stack.

The next item of interest is the very high furnace and grate efficiency. The ash pit in this case had a sloping bottom, and was visible throughout its extent from the door in the basement. Previous to these tests the pit was substantially clean and the condition noted. In the case of the Cherokee slack, the ash fused and ran down the bottom in molten streams, being removed partially in liquid form and partly by being broken away from the bottom with a bar after it had somewhat cooled. An examination of a piece of cold slag shows an appearance like that of black glass, without the slightest sign of any combustible.

Under the ordinary operating conditions of this plant using this coal and operating at times at low ratings, there is produced a mixture of fine sandy looking ash and melted slag. Examination of a car load of this refuse standing on the side track of the plant failed to reveal any traces of unburned coal or coke. A sample was secured by taking a little from various parts of the car which analysed as follows:

| | |
|---|---|
| Per cent moisture | 13.00 |
| Per cent ash, dry basis | 97.40 |
| Per cent combustible matter, dry basis | 2.60 |

If all of the refuse could have been collected and weighed the weight would have been equal to 18.50 per cent of the dry coal fired. There would have been, therefore, 0.48 per cent ash pit loss. The ash pit loss with stokers will run from 2 to 5 per cent, so that there is in stoker practice from four to ten times as much ash pit loss as with powdered coal.

During these tests there was a light gray haze apparent at the top of the stack. A sample of dust was obtained from the breeching, which was very fine in size and of a gray color. Analysis showed that there was two per cent of combustible matter in the fine dust.

Another matter bearing on the high furnace efficiencies is the item of heat absorbed by excess air. It was without the slightest difficulty that the $CO_2$ in the flue gases was carried up to 16 per cent, readings frequently going to 17 per cent, and but few readings being less than 15 per cent. Considerable care was exercised in making the analysis for CO, there being the natural thought that with the high $CO_2$ that some loss from incomplete combustion might occur. The CO loss was in direct proportion to the length of the flame. Some relation, therefore, between the proportion of volatile matter in the fuel and the CO loss becomes apparent.

Pyrometer readings showed a furnace temperature between 2300 deg. F. and 2400 deg. F., under which conditions brick work may be maintained indefinitely, and which is above the fusing point of the ash from many coals. This furnace had been in constant service for nine or ten months, and the interior was in perfectly good shape.

TABLE II—HEAT BALANCE PER POUND OF COAL

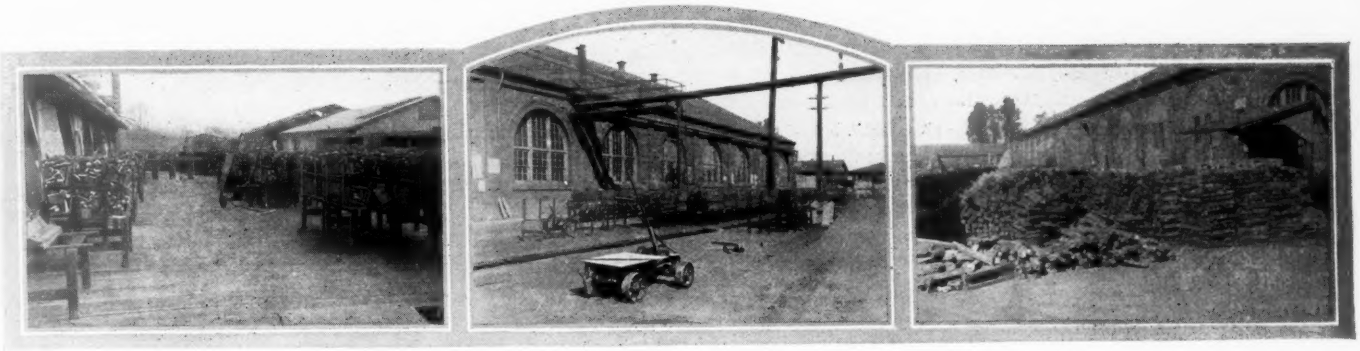
| | Texas Lignite | | Cherokee Slack | | Semi-Anthracite | |
|---|---|---|---|---|---|---|
| | B.t.u. | Per cent | B.t.u. | Per cent | B.t.u. | Per cent |
| Heat per lb. coal as fired | 8,854 | 100.00 | 12,056 | 100.00 | 12,587 | 100.00 |
| Heat absorbed by water in boiler | 5,073 | 57.32 | 6,992 | 58.00 | 8,765 | 69.64 |
| Necessary Losses: | | | | | | |
| Heat to moisture and burned H. up to temp. of steam | 581 | 6.56 | 473 | 3.92 | 365 | 2.90 |
| Heat to theoretical amount dry gas up to temp. of steam | 441 | 4.98 | 618 | 5.13 | 607 | 4.82 |
| Heat available for use | 7,832 | ..... | 10,965 | ..... | 11,615 | ..... |
| Highest theoretical efficiency | ..... | 88.46 | ..... | 90.88 | ..... | 92.27 |
| Furnace Losses: | | | | | | |
| Heat to excess air up to steam temp | 50 | 0.57 | 100 | 0.83 | 67 | 0.53 |
| Heat loss due to CO | 75 | 0.86 | 44 | 0.37 | ..... | ..... |
| Heat available for boiler | 7,707 | 87.05 | 10,821 | 89.76 | 11,548 | 91.75 |
| Furnace efficiency | ..... | 98.40 | ..... | 98.69 | ..... | 99.44 |
| Boiler Losses: | | | | | | |
| Heat to theoretical amount of dry gas, moisture and H. above steam temp. | 465 | 5.25 | 438 | 3.64 | 675 | 5.36 |
| Heat loss due to air leakage through setting | 120 | 1.36 | 29 | 0.24 | 52 | 0.41 |
| Radiation and unaccounted for losses | 2.049 | 23.12 | 3,362 | 27.88 | 2,056 | 16.33 |
| Boiler efficiency | ..... | 65.82 | ..... | 64.61 | ..... | 75.90 |
| Combined efficiency | ..... | 57.32 | ..... | 58.00 | ..... | 69.64 |
| Ratic comb. eff. to highest theor. eff. | ..... | 64.80 | ..... | 63.90 | ..... | 75.49 |

The ash from the lignite and semi-anthracite coals did not fuse, and there was a small deposit in the ash pit of a yellow sandy looking ash which appeared to be entirely free of combustible matter.

Another and most interesting phase of these tests is the draft loss in the boiler. A drop in draft between the top of the third pass and the furnace of around 0.05 in., in a boiler ten tiers of tubes in height, operating at 25 or 30 per cent above its rating, does not seem natural, but the draft readings throughout all three tests were checked and repeatedly verified. These boilers are equipped with 60-ft. stacks, and were operated with the stack damper partially closed in order to get the furnace draft nearly neutral. The small loss is probably due to the small gas volume and consequent low frictional resistance in the boiler.

There is without doubt a certain amount of the ash dust which adheres to the furnace walls, and if such ash has a fluxing effect on the brick, ultimate destruction will occur. On the other hand, if it is desirable to liquefy the ash the furnace can be designed to produce a temperature which will be above the fusing point, and the substantially complete removal of the ash in this form thereby effected.

One of the questions which heretofore has frequently been asked is relative to the slagging of the tubes from fused ash adhering thereto, and forming an objectionable coating on the exposed surfaces. During the three days when these boilers were under observation there was no sign of any formation of this nature.



# Reclamation on the Southern Pacific

## A Description of the Extensive Salvage Work Done in the Largest Railroad Shop on the Pacific Coast

BY FRANK A. STANLEY

II

IN the first installment of this article reference was made to the reclamation at the scrap docks of the Sacramento shops of many such items as bolts, oil box covers, shoe and wedge lining, washers, valves, and numerous other parts that admit of being put into serviceable condition and are, therefore, in a class distinctive from the material that is actually scrapped and sent to the foundry, mill and forge for

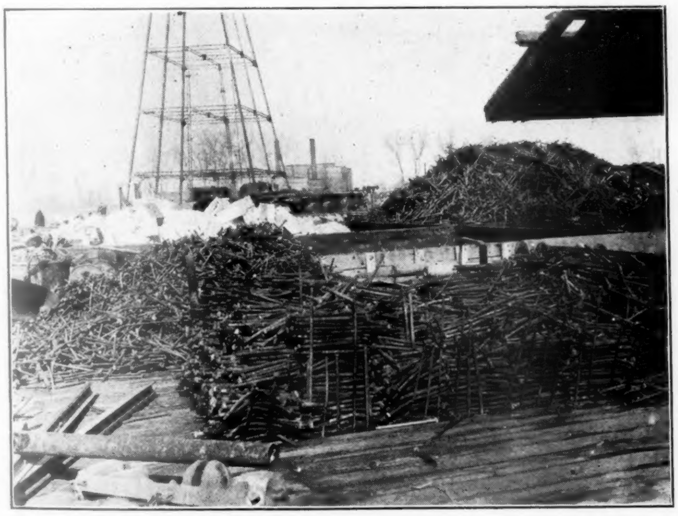


Fig. 13—Sorted Bolts Ready for Reclaiming

working into castings and stock for fresh material. The sorting out of parts suitable for immediate reclamation is a process that is carried on with as great a degree of celerity as possible and as rapidly as any group of bolts, covers or other pieces is accumulated in sufficient numbers the parts are run through the necessary operations to make them suitable for storing and issuing as required.

Thus, in Fig. 13, a number of piles of bolts and nuts are represented as sorted for reclaiming, an undertaking accomplished by the simple operations of cutting off the worn threaded ends, straightening the body, rethreading, and in the case of the nuts, retapping. The principal bolt shop is naturally located in the main shops and where bolts and nuts are overhauled in great quantities much of the work is sent there from the reclamation docks.

### BOX COVERS, SHOES AND WEDGES

The pile of parts in Fig. 14 is a portion of a considerable accumulation of oil box covers that arrive in great numbers at the scrap docks. These are in some instances sheet metal stampings, in others malleable castings. In either case the work of reclamation consists in heating and straightening the flat covers, straightening out the hinge ends for the pins, closing the ends where sprung open, etc., all operations performed in the smithy on the scrap docks.

The view in Fig. 15 shows a pile of shoes and wedges on the reclamation platform where the brass is melted out as mentioned in the article last month. The furnace for the work is seen at the left and as there indicated it is fired by oil fuel. The amount of brass thus saved from old shoes and wedges will run to about 2,600 lb. in two weeks' time. Ma-

Fig. 14—Oil Box Covers to be Straightened

terial of this nature is constantly coming in from all over the system and the total saving of brass from various classes of parts runs into a very high figure.

### CAR BRASSES

Along this line few features of the reclamation project are more important than the saving of material in the way of old

car brasses, which by the way, are overhauled in the main plant, in the babbitt shop. Formerly up to ten or a dozen years ago, practically all car and truck brasses, as the babbitt lining wore out or burned out, were discarded and sold to the junk dealers and entirely new brasses put into their places. Now the old brasses all come back to the babbitt shop at the Sacramento plant and are here relined with new babbitt unless worn too thin for further service, or too short on the ends for use.

This means a considerable saving of old babbitt which is

Fig. 15—Furnace for Melting Liners from Shoes and Wedges

melted out of the brasses and a much more important saving in the brasses themselves, which under usual conditions of service will last for a good many years. Some conception of the extent of operations in this direction is gathered from the fact that the babbitt shop referred to relines as many as 3,000 old brasses in the course of a month, this in addition to an output of new brasses running up to some 4,500 in number.

In these operations and in pouring other classes of work the babbitt shop will run about a ton of babbitt a day. For

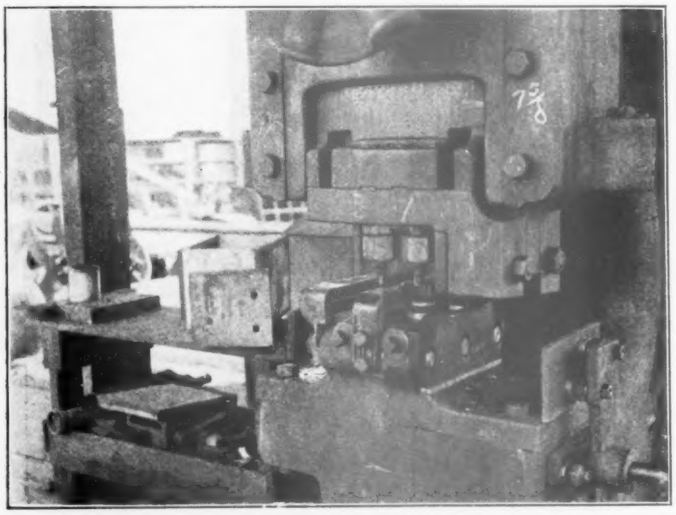


Fig. 16.—Gang Punch for Tie Plates

brasses alone the babbitt used per month runs up to over 40,000 lb., about 20 per cent of this going into the relining of old brasses and the remainder into new work.

Old babbitt recovered from worn brasses, from crossheads, etc., constitutes the bulk of the material required for pouring both old and new brasses. To this reclaimed babbitt enough new metal is, of course, added to bring the material up to the analysis to which the lining metal must be held.

MAKING UP BILLETS FOR THE MILL

Returning now to the reclamation docks proper, a large number of box-piles ready to be sent to the rolling mills are shown on the platforms, in the illustrations at the head of this article. The box-pile is built up on a board, on which binding straps of flat stock are placed, with the scrap piled between sections of plate which have been cut roughly to size by power shears and flame cutting torch.

The assortment of scrap bolts, rod ends, pins and so on is built up neatly and then bound by closing the straps in an air operated machine. The finished box-piles are placed on carrying stands, each holding a half-dozen or more box-piles, which are made up of a stiff metal skeleton form that admits of being picked up and moved about by the lifting truck shown in the illustrations. This truck is backed under a stand and then a pull of the upright lever lifts the truck body and clears the stand and its load from the floor, so that it may be transferred easily to any other point in the shop and as easily deposited.

The box-piles are hauled on flat cars around to the mill siding and there unloaded for the heating furnaces. Several long rows of stands with their billets in front of the mill department are shown in the center photograph. The lifting trucks are here also used in numbers for transporting the material about the mill and yard platforms.

The roughed square stock as it issues from the mill rolls

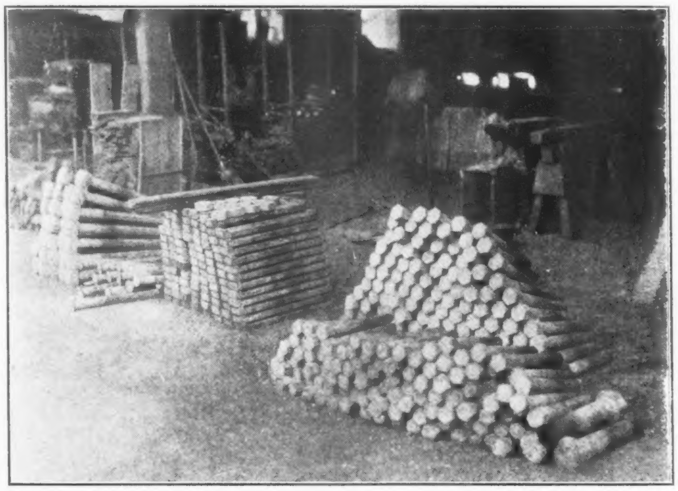


Fig. 17—Some of the Sizes of Bolts Manufactured

is seen piled up in short working lengths in the right-hand photograph. Merchant bar products are made in great quantity in rounds, squares, flats and other sections for general use and manufacturing purposes in the various shop departments.

PUNCHING TIE PLATES

Tie plates are manufactured in large numbers. The method of punching them is illustrated in Fig. 16. There are four punches combined in one gang for forming all four holes at one stroke of the machine. The dies carry the shear at the right hand side, the stop further to the right and a stripper is placed across the center of the die block to clear the four round dies inserted in the face of the block.

Some of the large sizes of bolts and nut blanks manufactured are seen in Fig. 17. The nuts are produced by heading up the end of the round bar as in forming a bolt head, and then punching through the center of the hexagon head and so forcing out the core of the nut blank as an integral part of the round bar of stock. One set of dies upsets the hexagon form on the end of the hot metal and then the bar is dropped into the lower die for the punching out of the center, which clears the bar from the pierced nut blank.


## EFFECT OF HOLES IN THE SIDES OF BOX BOLSTERS

BY L. E. ENDSLEY
Professor, Railway Mechanical Engineering, University of Pittsburgh

In a paper read by the writer before the St. Louis Railway Club, in May of this year,* it was shown that straightening the bottom or tension member, closing the usual openings in the tension member and casting holes in the side walls gave a box truck bolster of considerably less maximum stress, both in the tension and compression members, than a bolster of the same general design and weight having the ordinary curved bottom or tension member with the usual holes in this member and no holes in the side walls.

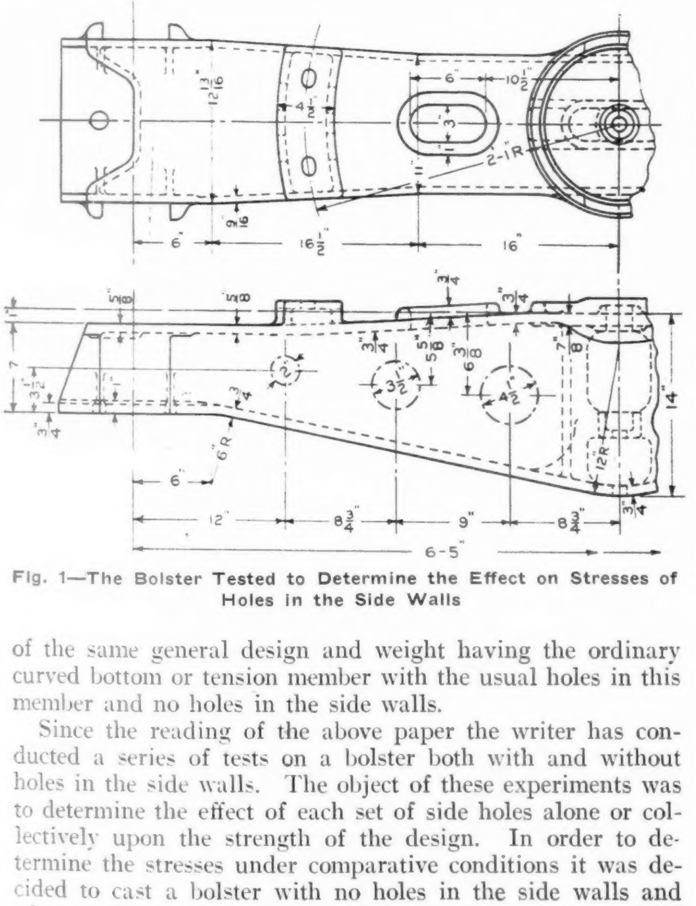


Fig. 1—The Bolster Tested to Determine the Effect on Stresses of Holes in the Side Walls

Since the reading of the above paper the writer has conducted a series of tests on a bolster both with and without holes in the side walls. The object of these experiments was to determine the effect of each set of side holes alone or collectively upon the strength of the design. In order to determine the stresses under comparative conditions it was decided to cast a bolster with no holes in the side walls and after testing by means of the Berry strain gage to machine out the holes, four at a time, and test after each set of holes were machined. This was done to eliminate such variables as might occur in two separately cast bolsters.

The bolster used throughout these tests was cast as shown in Fig. 1 without the twelve holes in the sides, the location of which are shown by dot and dash lines in the half side elevation. The hole in the top of the bolster was cast as shown in the top view. The bolster shown in Fig. 1 is identical with that shown in Fig. 10 of the previous article, with the execption that in Fig. 10 the holes were cast in the sides and a bead was cast around each hole. With this alteration the same pattern was used. However, the metal in the bottom or tension member of the bolster, the test results of which are given in Figs. 2 and 3, did not come up to the drawing dimensions, being generally less than that specied with the exception at the center of the bottom, where it was drawing size. This accounts for the stresses being somewhat greater than those previously recorded. This, however, did not influence in the least the comparisons as herein given of the same bolster both with and without the side holes.

The bolster was first tested without any holes in the side walls, and Fig. 2 gives the stresses in the bolster under the combined method of loading, which amounted to 150,000 lb. total load. After this test was conducted, the four large center holes 4½ in. in diameter were machined in the side walls and a second test was made under the same loading; after this the next largest four holes, those 3½ in. in diameter, were machined and a third test made. The four outer holes, which are 2 in. in diameter, were then machined and the fourth test, that given in Fig. 3, was conducted.

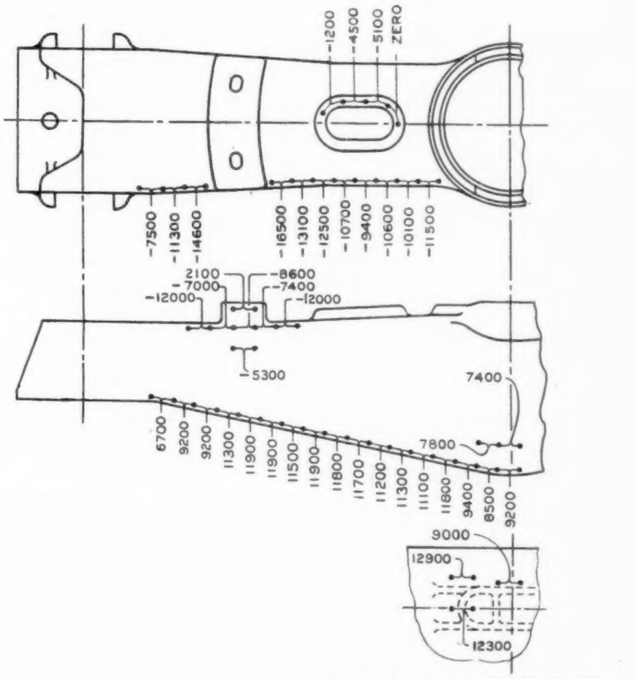



Fig. 2—Stresses in Bolster with Solid Sides under 150,000-Lb. Combined Load

The results of the second and third tests are not given in this paper for the reason that, comparable with the first test with no holes in the side walls, there was practically no difference in the stress in the compression and tension members, following the insertion of the first and second sets of holes. It

*See the *Railway Mechanical Engineer* for June, 1918, page 343

will be seen that there is a slight increase of stress in the fourth test over that in the first test along the bottom or tension member at certain points.

By averaging these tension stresses on the bottom member from just outside of the outer set of holes to a point just inside of the inner set of holes we obtain 11,300 lb. stress per sq. in. without the holes in the bolster and only 300 lb. increase in stress with the 12 holes in the bolster, showing that the addition of these holes did not have any material effect upon the stresses developed in the bolster.

Comparing the stresses around the holes in Fig. 3 it will be seen that they are somewhat higher than the stresses shown around the holes in Fig. 10 of the previous paper. This is due to the fact that there were no beads around the holes of

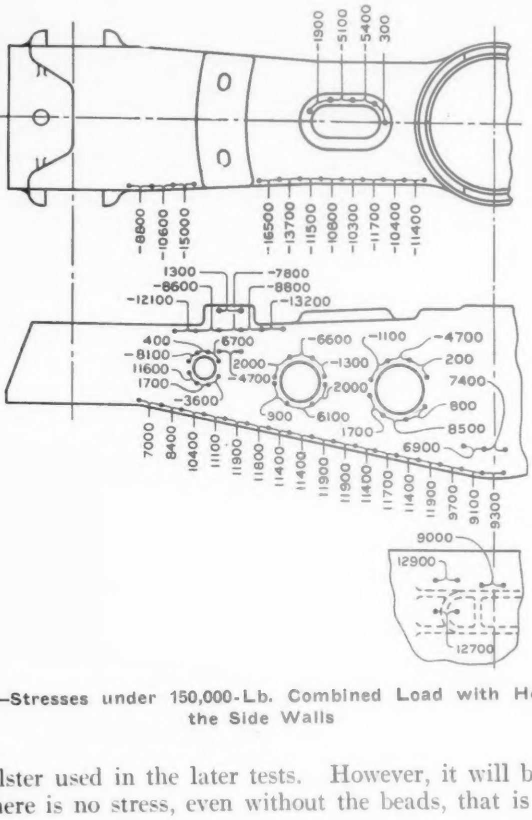



**Fig. 3—Stresses under 150,000-Lb. Combined Load with Holes in the Side Walls**

the bolster used in the later tests. However, it will be seen that there is no stress, even without the beads, that is at all serious.

It has been claimed by some foundrymen that casting box bolsters with holes in the side walls will materially reduce the foundry losses.

The results of all the tests conducted by the writer show clearly that a stronger bolster can be made by straightening the bottom of tension member, closing the usual holes in the bottom and for foundry requirements casting holes in the sides as indicated. Small holes in the side walls of a box bolster have no appreciable effect on its strength, provided the holes are properly located and of a size that will not decrease the transverse strength.

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WHERE GERMANY SECURES COPPER. — Before the war Germany obtained most of her copper from the United States, taking over one-third of our exports. Since Germany has extended her sphere of influence it is probable some supplies are coming from other countries. The Serbian copper mines are now being intensively exploited by the Germans and Austrians, and good copper deposits are also said to have been found in Poland. Work has begun in lead and copper mines in Kielce; and in Miedziana, Lysa Gora and Olkuss the methodical exploitation of these ores has recently been started.—*The Valve World.*

## BRAKE PIPE LEAKAGE

In discussing a paper on the question of Air Brake Maintenance before the New England Railroad Club, H. S. Walton, supervisor of air brakes, Boston & Albany, spoke on brake pipe leakage, saying, in part, as follows:

"The practice of the train men pulling the air hose apart results in a great deal of trouble as it causes leaks in the train pipe. It not only injures the hose, ruptures the lining and causes it to become porous, and injures the couplings themselves, but the constant shocks applied to the brake pipe itself by pulling the hose apart eventually loosen the joints. All roads should instruct the trainmen to separate the hose by hand and we should see that they *do it.* To show how expensive brake pipe leakage may be I will quote from a paper which I prepared and read before this Club in January, 1917:

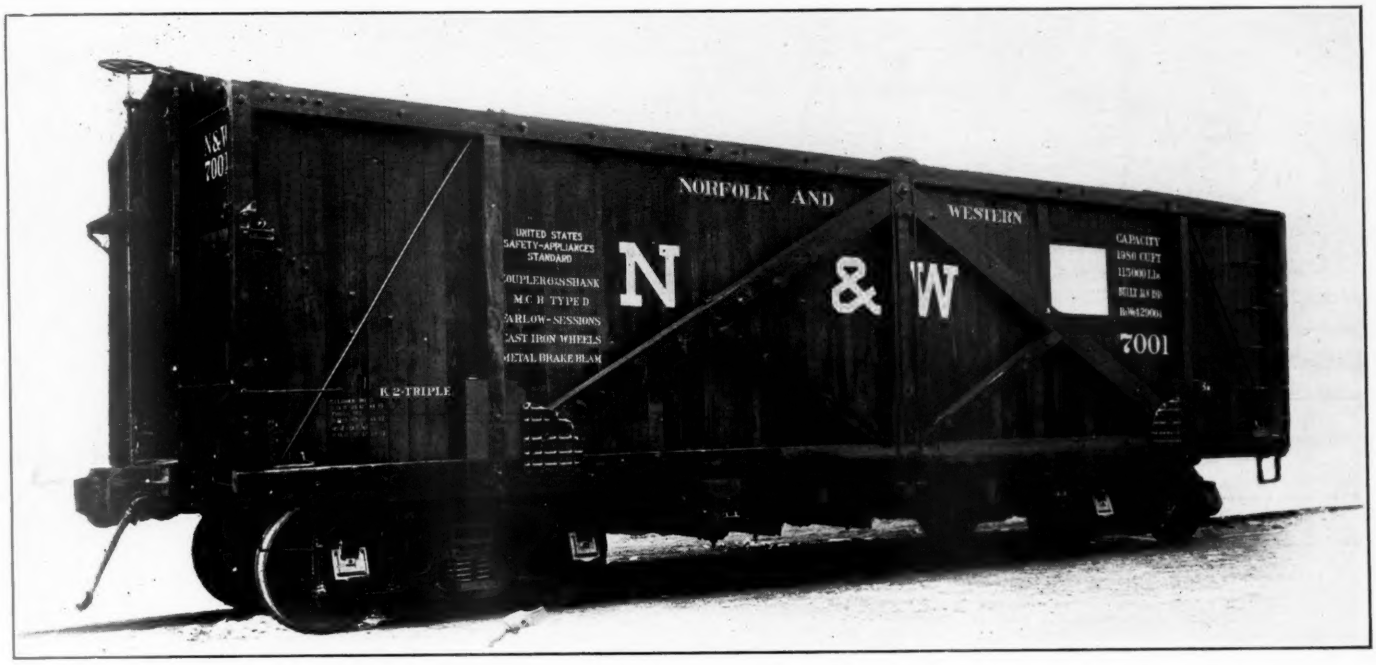
" 'Brake pipe leakage is very expensive when we consider the wear and tear of the pump and the additional consumption of fuel. Let us consider the latter in connection with a 70 car train assumed to have one-half eight-inch, and one-half ten-inch equipment. A leakage of 5 lb. per minute on this train, with a 70 lb. train pipe pressure would amount to 39.5 cu. ft. of free air per minute, or 23,700 cu. ft. of free air in ten hours. The 8½-in. cross compound pump, driven with 200 lb. steam pressure would require 3 hours and 5 minutes to compress the air lost, and in doing that amount of work 5,782 lb. of water would be evaporated; and assuming that 8.5 lb. of water is evaporated with one pound of coal 680 lb. of coal would be consumed.

" 'The New York No. 5 pump would require 3 hours and 20 minutes to do the same amount of work and would use 10,475 lb. of water and 1,230 lb. of coal. For the 9½-in. pump this work would require 9 hours and 11 minutes with 15,144 lb. of water and 1,780 lb. of coal.'

"If there is any one connected with a railroad in this section of the country that can find a 70-car train with a leakage as low as 5 lb. per minute I will pay for this dinner tonight. If you add to the air wasted in brake-pipe leakage the air wasted in making sufficient reduction to develop the maximum braking power of cars with a long piston travel, you will find that it will greatly increase the consumption of coal used or required to compress air that is wasted, and I don't need to tell you what coal is worth in these days. It is almost as valuable as gold."

C. H. Larimer of the Westinghouse Air Brake, who was also present at the meeting, said:

"In this territory the most of the caboose cars have been equipped with a pressure gage connected to the brake pipe line and it will no doubt be interesting to know just what a difference in the gage pressures between the forward and rear end of the train indicates in number of cubic feet free air leakage per minute. With a train of fifty cars, 70 lb. pressure on the first car and gage in the caboose reading 67 lb., it would indicate a loss due to leakage of 38.7 cu. ft.; a 5 lb. difference, a loss of 52 cu. ft.; a 7 lb. difference, a loss of 61 cu. ft., and should the pressure be held at 70 lb. on the first car with a drop of 20 lb. on the gage in the caboose it would mean that 106 cu. ft. of air is being wasted due to the leakage. Looking at this leakage in the light of an expense, that the most economical compressor uses 30 lb. steam per 100 cu. ft. free air compressed, and that the modern locomotive with its superheater, arch, combustion chamber and feed water heater evaporates 10 lb. of water to a pound of coal, with coal at $10 a ton, the cost of displacing 100 ft. of air would be $.015. A ten-hour run would mean then that 60,000 ft. of air would be lost at a cost of $9. If, the difference between the first car and the caboose was 7 lb. which it is frequently, the loss would amount to, on the same basis, $5."




# LARGE CAPACITY WOODEN HOPPER CAR

**Built by the N. & W.; King Post Side Trusses; Large Pocket Castings Extensively Used in Fanning**

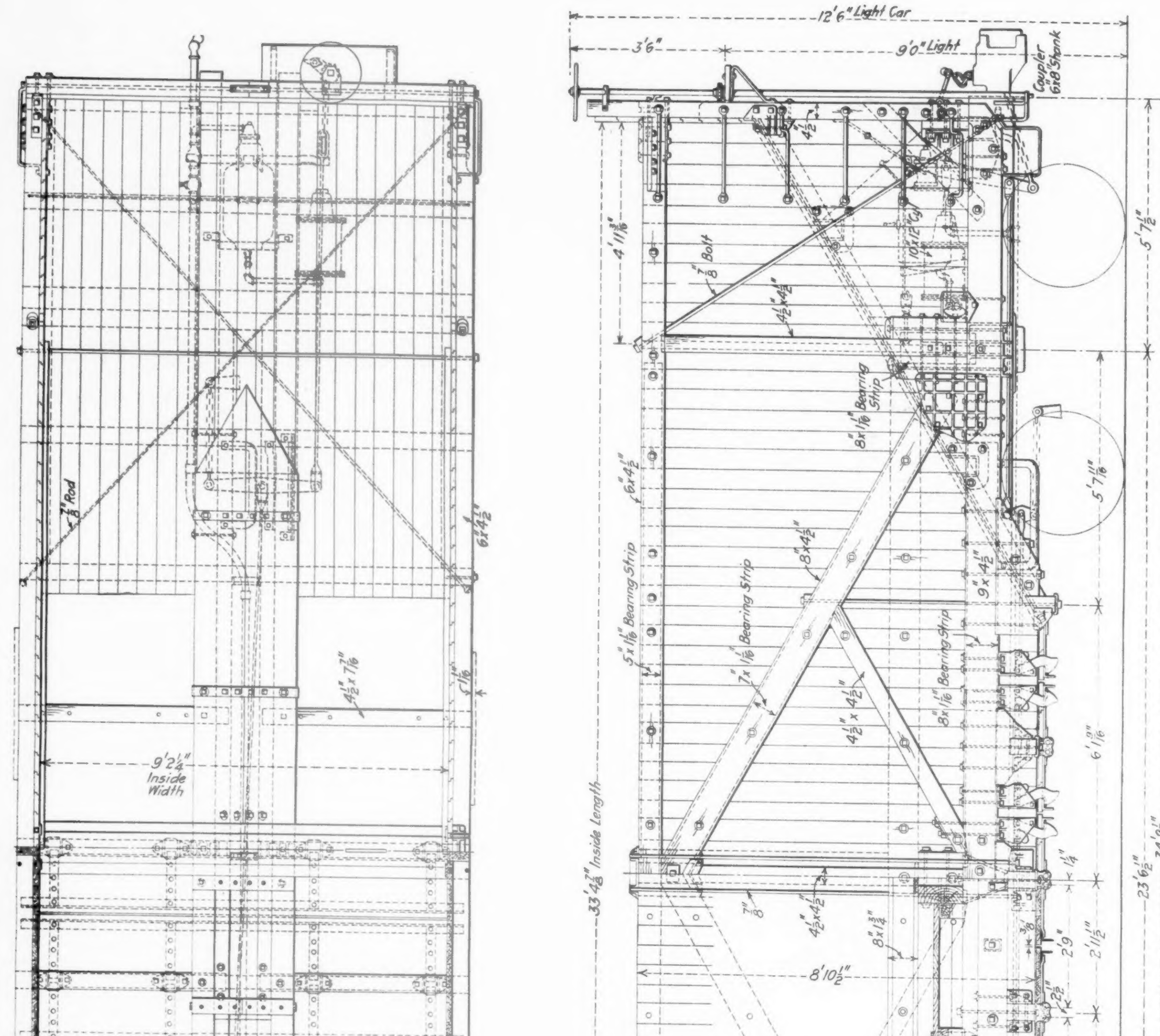
DURING the latter part of 1917 and early in 1918 the Norfolk & Western started the construction of 2,000 cars, all but ten of which are of composite wood and steel construction. These cars are built up on a steel center sill and bolster foundation, the remainder of the construction being wood throughout. Ten of the cars were built of wood throughout, including the center sills and bolsters, largely for the purpose of demonstrating the possibilities of all-wood construction in cars of this capacity. With the exception of the center sills, bolsters and draft gear attachments, both the all-wood and the composite cars are practically identical in design.

The cars of all-wood construction are built up on continuous center sills of 6-in. by 12-in. section placed 15½ in. apart. The bolsters are made up of two 16-in. by 20-in. timbers which are spaced 4½ in. apart and are placed over the center sills. These timbers are attached to the center sills by means of the center plate casting, which is designed to form a filler both between the center sills and the bolster members. Further means of attachment is provided by cast iron brackets attached to the outside faces of the center sills and to the bottom of the bolster members. These brackets are also provided with fillers which extend upward between the bolster timbers.

The draft gear, which is the Sessions Type K, is carried directly by the center sills, the center line of the gear being located 4 1/16 in. above the lower face of the sills. The pulling stresses on the draft gear are transferred directly from the follower plate to the cheek plates. Each cheek plate is cast with four vertical keys, which fit into the cross gains in the sills so that the stress is delivered against the end grain of the wood, the bolts only serving to hold the key plates against the sills. In order that the forward keys may be kept well back from the ends of the sills, the coupler shank is made 28 in. long. In buffing the coupler yoke bears directly against a projection on the center plate casting, and the cheek plate attachments to the sills are subjected to stress in but one direction. Buffing sills of 4-in. by 8-in. section are placed between and flush with the bottom of the center sills. The ends of these timbers are fitted in pockets in the back of the center plate castings so that the buffing stresses are transmitted directly through the center plate casting to the end grain of the buffing sills, and no shearing stress is imposed on the bolts by which the casting is attached to the center sills.

End sills of 4½-in. by 12-in. section are placed across and directly above the center sills, to which they are bolted. The ends of the center sills are thus supported from the side frames of the car and also from the trussed hopper end by 4½-in. by 4½-in. posts placed in the outer angles between the center sills and the end sill. The ends of the center sills are tied together and capped by a malleable iron casting to which is attached the coupler carrier iron and the dead wood block. The latter is 8 in. deep by 4 in. high and is faced with a steel plate 1¼ in. thick. The carrier iron is a 5-in. by 3½-in. by 7/16-in. angle 27⅛ in. long with the horizontal flange turned up to form the coupler limit stops.

The car bodies are designed in the form of king post side trusses, which relieve the center sills of a large part of the weight of the lading. These trusses have 4½-in. by 9-in. side sills, and 4½-in. by 6-in. plates, between which are three 4½-in. by 4½-in. posts, two of which are located at the bolsters and the other at the center of the car. Main diagonal members of 8-in. by 4½-in. section extend from the top of the car at the center to footings at the bolsters, the connection at this point being made by a large iron pocket casting the keys of which are gained into the side sills. The tension member at the center of the truss consists of two ⅞-in. U bolts, which straddle the frame and are secured below the center sills. Where the bottom of the hopper chutes are secured to the sills, they are supported directly from the main diagonals by ⅞-in. tension members, the truss form being retained at these points by the use of 4½-in. square diagonal compression members, which carry their load

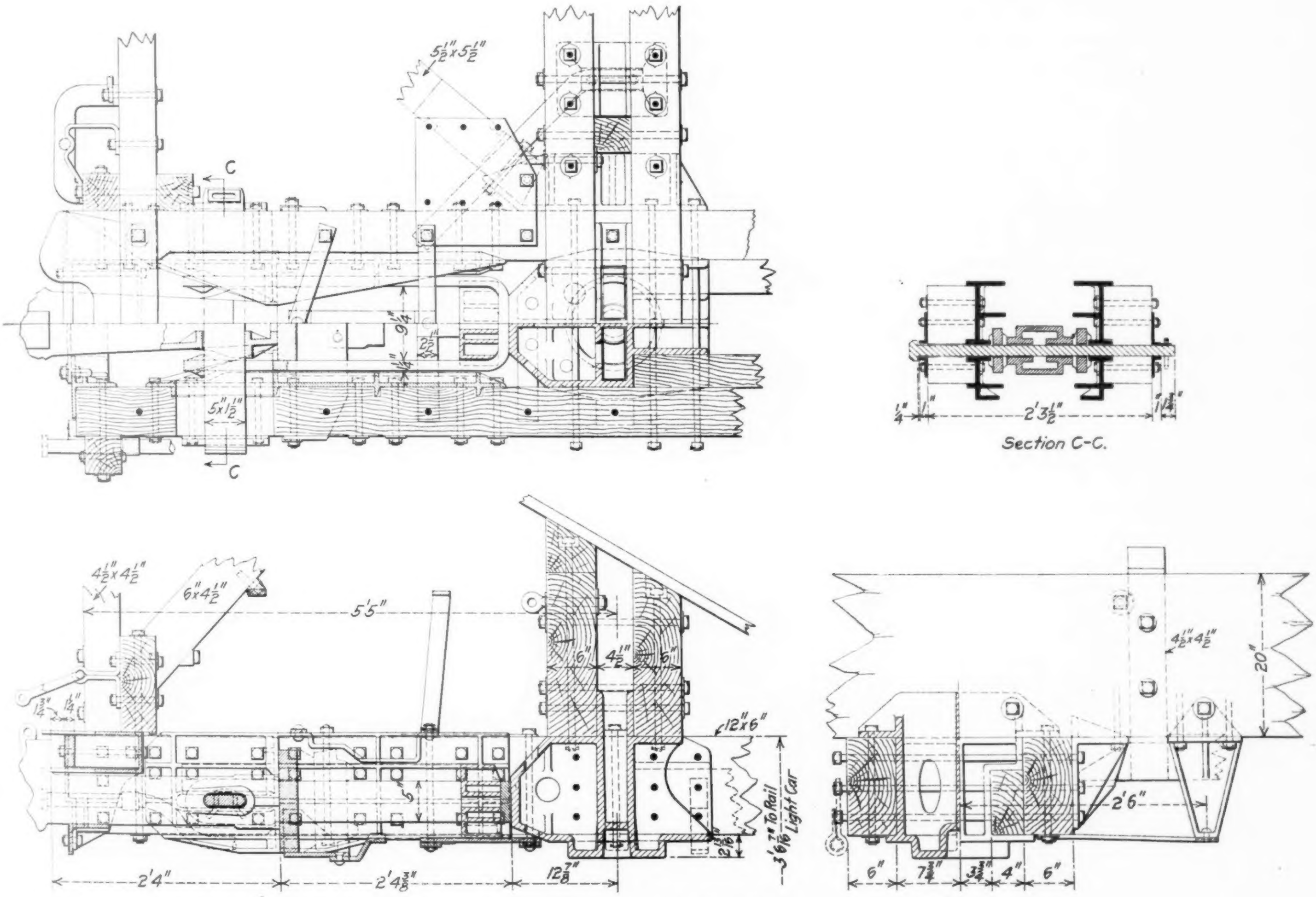



Plan and Elevation of the N. & W. Wooden Hopper Car

to the main vertical tension member at the center of the truss. The overhang of the side frames at the ends of the car is supported by 7/8-in. diagonal rods.

The load on the center sills at the middle of the car is transferred across to the side frame by a needle beam made up to two 4½-in. by 12-in. pieces placed across the car above the sills.

The car has four sets of double doors, hinged from cross timbers, supported from the side and center sills. These doors clear about 2 ft. 9 in. in width and extend continuously across the car. When the doors are closed they are supported only at the ends, the edges of the doors being reinforced by angle irons of sufficient stiffness to support the load between the sides of the car. The ends of these angles project slightly beyond the sides of the car, where they engage the hooks which hold the doors closed. The door locking device is simple in construction. It is manufactured by the Wine to the side frame members, with every support board bolted in place. On the inside of the car horizontal retaining strips are attached to the sides to prevent the board from being loosened from the frame by the pounding, which is often necessary to dislodge the coal in the car. The chute boards, beside being supported at both ends and over the bolsters, are provided with two intermediate supports attached to the side planking of the car by cast iron pockets of ample dimensions. The lower one is gained over the center sills, and the upper one is supported from the end sill by 6-in. by 4-in. diagonal struts. Beneath the chute are two diagonal truss rods, each running from the top of the chute at one side of the car to the bottom of the chute at the other side. The chute is thus in effect a diagonal transverse truss which holds the side frames securely in alignment, and resists any tendency towards weaving of the whole structure. The sides of the car are tied together at the top by five 7/8-in. cross bolts.




Draft Gear and Bolster Details

Railway Appliance Company and is the same as that used on the 100-ton steel hopper coal cars of the Norfolk & Western.*

It will be seen that the arrangement of the doors is such that half of the load at the inside of the doors is carried by the center sills and half by the side sills, while the total load at the swinging side of the doors is supported by the side sills. The center sills thus support one-quarter of the total load resting on the door, and this is in turn transmitted to the side frames through the bolsters and the needle beam at the center of the car.

The siding and chutes are made of ship lapped material 1 5/16 in. thick. The siding is applied vertically and spiked

*See the *Railway Mechanical Engineer* for February, 1918, page 96.

The design of the car is characterized by the extent to which use has been made of pockets and corner castings of liberal dimensions for the connection of the various members of the frames. These are provided with keys gained into the wood members, whenever the stress tends to exert a shearing action on the bolts by which they are attached to the wood.

The trucks are built up of cast steel side frames and bolsters and have 5½-in. by 10-in. journals. The wheels are cast iron, 33 in. in diameter, and the wheel base is 5 ft. 6 in.

Some of the all-wood cars have now been in service as long as seven and eight months, and have been handled in heavy trains made up largely of steel cars. A recent examination indicates that so far there has been no shrinking of the wood or other loosening of the joints in the frame structure. As far

as may be judged from this limited period of service, the design is a successful one.

The following are the more important dimensions of the all-wood cars:

| | |
|---|---|
| Length inside | 33 ft. 4⅞ in. |
| Coupled length | 37 ft. 1 in. |
| Distance between truck centers | 23 ft. 6½ in. |
| Inside width | 9 ft. 2¼ in. |
| Width to clear | 10 ft. 4 in. |
| Top of sides above the rail | 10 ft. 9½ in. |
| Capacity | 57½ tons |
| Light weight | 42,300 lb. |
| Cubic capacity level full | 1,980 cu. ft. |
| Cubic capacity with 30-deg. heap | 2,350 cu. ft. |

## ALLOCATION OF THE 100,000 STANDARD CARS

The following table gives the allocation of the Railroad Administration's 100,000 standard freight cars as determined by the Division of Operation. It will be noticed that the cars are well distributed, only two roads, the Pennsylvania line west and the Baltimore & Ohio, being allocated over 5,000 cars. The Pennsylvania lines east and the New York Central proper will each receive 4,500.

ALLOCATION OF 100,000 STANDARD FREIGHT CARS

| Railroad | No. | Type of car |
|---|---|---|
| Ann Arbor | 300 | Single sheath box |
| Atlanta, Birmingham & Atlantic | 200 | Single sheath box |
| Atlanta, Birmingham & Atlantic | 150 | Gondola—drop bottom |
| Atlantic Coast Line | 500 | Single sheath box |
| Atlantic Coast Line | 750 | Gondola—drop bottom |
| Atchison, Topeka & Santa Fe | 1,700 | Double sheath box |
| Atchison, Topeka & Santa Fe | 1,000 | Gondola—drop bottom |
| Bangor & Aroostook | 300 | Single sheath box |
| Big Four | 1,000 | Double sheath box |
| Big Four | 1,000 | Hopper |
| Bessemer & Lake Erie | 500 | Hopper |
| Boston & Maine | 1,500 | Single sheath box |
| Boston & Maine | 1,000 | Gondola—drop bottom |
| Baltimore & Ohio | 2,000 | Single sheath box |
| Baltimore & Ohio | 500 | Gondola—low side |
| Baltimore & Ohio | 2,000 | Hopper |
| Baltimore & Ohio | 1,000 | Gondola—drop bottom |
| Buffalo, Rochester & Pittsburgh | 800 | Hopper |
| Carolina, Clinchfield & Ohio | 300 | Single sheath box |
| Carolina, Clinchfield & Ohio | 750 | Hopper |
| Chicago & Alton | 500 | Gondola—drop bottom |
| Charleston & Western Carolina | 300 | Single sheath box |
| Chicago, Burlington & Quincy | 1,500 | Double sheath box |
| Chicago & Northwestern | 2,250 | Double sheath box |
| Chicago & Northwestern | 1,000 | Gondola—drop bottom |
| Chicago, Indianapolis & St. Louis | 300 | Double sheath box |
| Cincinnati, Indianapolis & Western | 300 | Gondola—drop bottom |
| Central of New Jersey | 1,000 | Single sheath box |
| Central of New Jersey | 500 | Gondola—low side |
| Central of New Jersey | 500 | Hopper |
| Chicago & Eastern Illinois | 500 | Double sheath box |
| Chicago & Eastern Illinois | 500 | Gondola—drop bottom |
| Chesapeake & Ohio | 1,000 | Single sheath box |
| Chesapeake & Ohio | 2,000 | Hopper |
| Colorado & Southern | 300 | Double sheath box |
| Chicago, Rock Island & Pacific | 1,000 | Double sheath box |
| Chicago, Rock Island & Pacific | 1,000 | Gondola—drop bottom |
| Chicago, St. Paul, Minn. & Omaha | 500 | Double sheath box |
| Chicago, St. Paul, Minn. & Omaha | 200 | Gondola—drop bottom |
| Delaware & Hudson | 500 | Single sheath box |
| Delaware & Hudson | 1,000 | Hopper |
| Delaware, Lackawanna & Western | 500 | Gondola—low side |
| Delaware, Lackawanna & Western | 700 | Hopper |
| Delaware, Lackawanna & Western | 500 | Gondola—drop bottom |
| Duluth, South Shore & Atlantic | 200 | Double sheath box |
| Detroit, Toledo & Ironton | 300 | Gondola—drop bottom |
| Elgin, Joliet & Eastern | 500 | Double sheath box |
| Erie | 1,000 | Single sheath box |
| Erie | 700 | Hopper |
| Erie | 800 | Gondola—drop bottom |
| El Paso & Southwestern | 500 | Double sheath box |
| El Paso & Southwestern | 200 | Gondola—drop bottom |
| Florida East Coast | 500 | Single sheath box |
| Georgia | 300 | Single sheath box |
| Georgia | 100 | Gondola—drop bottom |
| Great Northern | 1,500 | Double sheath box |
| Hocking Valley | 500 | Gondola—drop bottom |
| Illinois Central | 2,000 | Double sheath box |
| Kansas City Southern | 300 | Double sheath box |
| Long Island | 500 | Single sheath box |
| Louisville & Nashville | 2,000 | Hopper |
| Louisville & Nashville | 2,000 | Gondola—drop bottom |
| Lehigh Valley | 1,000 | Single sheath box |
| Lehigh Valley | 500 | Gondola—low side |
| Lehigh Valley | 1,300 | Hopper |
| Lehigh Valley | 500 | Gondola—drop bottom |
| Michigan Central | 1,000 | Single sheath box |
| Michigan Central | 1,000 | Gondola—drop bottom |
| Maine Central | 500 | Single sheath box |
| Minneapolis & St. Louis | 300 | Double sheath box |
| Missouri Pacific | 1,500 | Double sheath box |
| Missouri Pacific (Including St. L. I. M. & S.) | 1,000 | Gondola—drop bottom |
| Northern Pacific | 1,000 | Double sheath box |
| Norfolk & Western | 800 | Single sheath box |
| Nashville, Chattanooga & St. Louis | 200 | Gondola—drop bottom |
| Norfolk Southern | 200 | Single sheath box |
| Northwestern Pacific | 100 | Double sheath box |
| New York, Chicago & St. Louis | 500 | Double sheath box |
| New York Central | 2,000 | Single sheath box |
| New York Central | 500 | Gondola—low side |
| New York Central | 1,000 | Hopper |
| New York Central (Including L. S. & M. S. and C. I. & S.) | 1,000 | Gondola—drop bottom |
| New York, New Haven & Hartford | 1,500 | Hopper |
| Pennsylvania | 2,000 | Single sheath box |
| Pennsylvania | 500 | Gondola—low side |
| Pennsylvania | 2,000 | Hopper |
| Pennsylvania Lines West | 2,000 | Single sheath box |
| Pennsylvania Lines West | 1,000 | Gondola—low side |
| Pennsylvania Lines West | 2,500 | Hopper |
| Pennsylvania Lines West (Including P. C. C. & St. L. and Vandalia.) | 2,000 | Gondola—drop bottom |
| Pere Marquette | 500 | Single sheath box |
| Pere Marquette | 500 | Gondola—drop bottom |
| Philadelphia & Reading | 1,000 | Single sheath box |
| Philadelphia & Reading | 500 | Gondola—low side |
| Philadelphia & Reading | 2,000 | Hopper |
| Pittsburgh & Lake Erie | 500 | Single sheath box |
| Pittsburgh & Lake Erie | 500 | Gondola—low side |
| Richmond, Fredericksburg & Potomac | 500 | Single sheath box |
| Seaboard Air Line | 500 | Single sheath box |
| Southern Railway (Including C. N. O. & T. P., A. G. S., N. O. & N. E., Harriman & N. E., Nor. Ala.) | 2,000 | Single sheath box |
| Southern Pacific | 2,000 | Double sheath box |
| Spokane, Portland & Seattle | 300 | Double sheath box |
| St. Louis-San Francisco | 1,500 | Double sheath box |
| St. Louis-San Francisco | 1,000 | Gondola—drop bottom |
| Toledo & Ohio Central | 250 | Double sheath box |
| Toledo & Ohio Central | 1,000 | Hopper |
| Texas & Pacific | 500 | Double sheath box |
| Toledo, St. Louis & Western | 500 | Double sheath box |
| Toledo, St. Louis & Western | 750 | Hopper |
| Union Pacific System (Includes O. S. L. and O. W. R. & N.) | 1,000 | Double sheath box |
| Wabash | 1,500 | Double sheath box |
| Wabash | 1,000 | Gondola—drop bottom |
| Wheeling & Lake Erie | 1,000 | Hopper |
| Western Maryland | 300 | Single sheath box |
| Total | 100,000 | |

SUMMARY

| | |
|---|---|
| Single sheath box | 25,000 |
| Double sheath box | 25,000 |
| Gondola—low side | 5,000 |
| Gondola—drop bottom | 20,000 |
| Hopper | 25,000 |
| | 100,000 |

## SAVE FUEL BY SAVING AIR

A committee composed of 27 members of the Air Brake Association met in Chicago, July 31, and drew up a number of recommendations for reducing train pipe leakage and thereby effecting a material saving in locomotive fuel consumption. These recommendations were presented at a meeting of railroad officers convened by Eugene McAuliffe, manager of fuel conservation section of the Railroad Administration, in Chicago, the following day.

The recommendations are as follows:

Realizing our country's present urgent need of fuel saving to the highest degree, and being actuated by a patriotic desire to be genuinely useful in its particular way, the Air Brake Association, through its president, F. J. Barry, has proffered its active assistance to the Railroad Administration's division on fuel conservation, of which you have been made the official head. Your acceptance of this assistance resulted in the convening of a special committee of supervising air brake men from 24 of the largest railroads of the United States. This committee's deliberations resulted in the consensus of opinion that its greatest and most needful help in fuel saving could be rendered through a materially decreased leakage in brake pipes on freight trains, which, according to careful expert estimate, is now the cause of a wastage of more than 6,000,000 tons of coal annually. This wastage can be materially cut down, in the opinion of the Air Brake Association Committee, quickly and with little additional cost, if the following recommendations be diligently and faithfully followed by the railroads and the government alike:

(1) In switching cars in hump yard service, hand brakes must be known to be in operative condition before dropping over the hump. Each cut should be ridden home and not be allowed to hit cars on make-up track at a speed exceeding three miles per hour, as excessive shocks result in loosened brake pipe and cylinder connections with attendant leakage

at joints. Same conditions apply to general yard switching, and similar care should be exercised.

(2) When hose are uncoupled, they must be separated by hand and not pulled apart. Pulling hose apart is not only the most prolific cause of brake pipe leakage, but the damage annually due to train parting, account of hose blowing off nipples, also bursting, due to fiber stress, results in damage running into thousands of dollars. Angle cocks first must be closed if brake pipe is charged.

(3) Ample time must be allowed properly to inspect the air brakes and place them in good working order before leaving terminals.

(4) Freight terminals where conditions and business handled justifies, should be provided with a yard testing plant, piped to reach all outbound trains. At all freight houses, loading sheds, team tracks and other places where cars in quantity are spotted for any purpose long enough to make repairs and test brakes, air should be provided to do such work.

(5) On shop and repair tracks provided with air, brakes should be cleaned and tested in accordance with M. C. B. rules and instructions. Weather permitting, hose and pipe connections shall be given soapsuds tests. Hose showing porosity shall be removed and all leaks eliminated before car is returned to service.

(6) Freight trains on arrival at terminals where inspectors are stationed to make immediate brake inspection and repairs, shall have slack stretched and left with brakes fully applied.

(7) Brake pipe leakage on outbound freight trains shall not exceed eight pounds per minute and preferably should not exceed five pounds per minute following a fifteen-pound service reduction from standard brake pipe pressure, with brake valve in lap position.

(8) A suitable pipe wrench should be furnished each caboose to enable trainmen to remove and replace hose and to tighten up leaks developing enroute. Instructions directing its use should be posted in each caboose.

(9) A rule should be put into effect that trainmen must apply an M. C. B. standard air brake defect card in cases where defects develop enroute, or for brakes cut out by them, defect to be checked off on back of card.

(10) Air compressor strainers must be known to be free of foreign matter before each trip and removed for cleaning if necessary. Steam pipe to compressor to be lagged outside of cab or jacket.

(11) Special effort must be made to reduce the leakage of the various air-operated devices on locomotives.

(12) In mounting air hose, the coupling should be gaged with an M. C. B. standard gage, and the couplings and coupling packing rings known to be standard.

(13) Special attention should be given to maintaining brake pipe, brake cylinder, reservoir, retaining valves and pipe secure to car.

(14) The importance of competent air brake supervision successfully to cope with existing conditions cannot be over estimated.

(15) In the recommendations submitted it is not the intent in any way to abrogate existing instructions or rules that are now in force that are more stringent than those recommended, as these recommendations are intended to represent maximum conditions.

The letter was signed by the members of the committee: L. P. Streeter, I. C., chairman; L. H. Albers, N. Y. C.; M. S. Belk, Sou. Ry. Lines; R. C. Burns, Penn. R.R.; H. A. Clark, Soo Line; H. A. Flynn, D. & H.; M. E. Hamilton, St. L.-S. F.; C. M. Kidd, N. & W.; Mark Purcell, N. P.; H. L. Sandhas, C. R. R. of N. J.; C. Terwilliger, N. Y., N. H. & H.; Robert Wark, No. Pac.; W. W. White, M. C.; L. S. Ayer, Sou. Pac.; J. A. Burke, Santa Fe; T. L. Burton, N. Y. C.; T. W. Dow, Erie; H. A. Glick, Bangor & Aroostook; E. Hartenstein, C. & A.; P. J. Langan, D. L. & W.; R. M. Long, P. & L. E.; C. H. Rawlings, D. & R. G.; H. S. Walton, Boston & Albany; C. H. Weaver, N. Y. C.; Geo. H. Wood, Santa Fe; H. F. Wood, Boston & Maine; F. M. Nellis, secretary.

## SETTLEMENT FOR DESTROYED CARS

BY A. M. ORR

It seems to me that the subject of the settlement for destroyed cars is worthy of renewed discussion. To present the subject in a new light, I will refer to the case of two cars, steel underframe box, of the same series, built in 1910. One of these cars had its superstructure burnt off on a foreign road in 1917, the other was reported destroyed by another foreign line in the same month. The road on which the superstructure was burnt off sent the car home as a flat car, it being in such good shape that intermediate roads did not realize that it had been in trouble. It came home in the usual way in ordinary service as it would have done had it been a flat car when first built. A defect card for "Body above sills destroyed by fire" was furnished the owner and the superstructure was rebuilt. The cost of rebuilding this car was greater than what the other road paid for the destroyed car! Why was this absurdity possible?

It was possible because the practice of the M. C. B. Association in the case of destroyed cars is based upon the answer to the question, "What did the car cost when new and how much depreciation has occurred, when calculated upon an accounting basis?" while in the case of repairs to cars the practice is based upon the answer to the question "What will it cost to replace the defective parts?" It seems to me that the latter method should be used also in the case of settling for cars destroyed, and I give below my reasons for taking this position.

A railroad being by force of events a continuing concern in 99 per cent of all cases, any car going out of service will have to be replaced as soon as possible in order to keep up with the continuously increasing demands for transportation service. When the car is destroyed on a foreign line, the expense to the owner is not the adjustment of the books of the accounting department, but the cost of replacing the car. As a matter of detail the number of the cars destroyed may be left vacant and replacement cars bought under other numbers, but the total of cars owned by a road never for any length of time shows a constant decrease.

If this position is correct, and I can not see how it can be successfully assailed, then remains the question, "How may the cost of replacement be determined?"

We should first consider the question of depreciation. This is a subject which has been handled from the beginning in accordance with the accounting principle which considers "depreciation" synonymous with "obsolescence," a deterioration which proceeds practically uniformly from the time a structure is built until conditions are so changed that the structure will no longer serve a useful purpose. This does not seem to be a proper method in the case of a car. As a matter of pure fact, the car depreciates in value to a great extent immediately upon its being put into service. It would probably be proper to say that all the overhead charges and car companies' profits should be taken away from the value of the car at the end of the first year, thus bringing the value down to the cost of replacing it in the shops of the owner, where there would be no profits to be considered and no actual increase in "shop overhead expense" on account of the rebuilding of one car.

Further, for about five years after its being put into service, a car is of more value than it is in later years because of the fact that for about that length of time it does not visit the repair tracks often, unless on account of a wreck, and is

therefore available for a longer period during the year for revenue service. Therefore, it would be proper to depreciate the value of the car to the owner further during that five years. It might be suggested that the car might be considered as depreciating 25 per cent the first year and 2½ each year for the four ensuing years, a total depreciation of 35 per cent, leaving the car at a value of 65 per cent of its original value from thence on.

You will note that distinction between this method and the present method lies in the fact that the proposed method considers two conditions: First—the scrap value of the car, perhaps 25 per cent of its value new under normal conditions. Second—a value which is like the "good will" of a business house, a factor of value fully recognized by law, the value of the car as a "going concern." In other words, any cars which will carry loads are immeasurably superior to cars which will not carry loads, and the owner should be recompensed for the loss of the ability to get the car home and use it, as well as for the scrap held in the hands of the destroying road.

In the second case, we have to consider the method of arriving at the base value of the car. The answer to this problem lies in the present rules, for the M. C. B. Association has for many years provided for the settlement of claims for destroyed cars on the basis of the price per pound which is set in M. C. B. Rule 112, a price which can be changed yearly if the Association finds it necessary on account of changed conditions. What no one has done so far apparently is to consider other classes of cars to see whether a pound price could be applied to cars in general. I have done so as far as limited opportunity permits and have found that there is less variation between the price per pound of different classes of cars built in the same year than there is in the price per pound of cars of the same class purchased in different years. The refrigerator costs more than the box car of similar construction but it weighs more. The gendola costs more than the flat, but weighs more. The price of the steel gondola will vary more between one year and another than will the gondola and the box car (per pound) in the same year.

Under the present system we have a very complicated method of arriving at the base cost of a car, a method which some seem to wish to make more complicated each year. The system, like every other system which concerns a continuing proposition as the railroads on as large a scale as the railroads of the United States, will in the long run bring results which will be perfectly fair to all concerned. As a by-product the present system makes it necessary to have a force of clerks who can keep track of the complicated methods of the rules and another force of clerks who keep track of the values of the cars built after 1914 in order to furnish the information at any time on any car. Not much labor perhaps on any one road, but considerable when all roads are concerned.

If the M. C. B. Rules would be changed to make the base price of all cars what the base price of steel cars now is, the price per pound at the weight of the car at its last weighing, there would be a system of settlement which would not require any complicated method or learned clerks. Just two facts, "How much did the car weigh?" "How old was the car?"

If the rules would adopt the method suggested on depreciation in place of the present one based on "obsolescence," and would set a price per pound which would represent the value of the average car, the case would still be simpler. Then there would be but one question, "What is the weight stencilled on the car?"

In this discussion I have neglected the allowances for friction draft gear, wrought steel wheels, steel center sills, metal body bolsters, and so on. These extra allowances were allowed by the Association to foster the equipment of cars with things which would make the cars better. There would be no objections from the accounting standpoint were that system to be continued, although it would keep part of the present complications of billing still in force. We must stand for some complication if a useful purpose is subserved.

To sum up, it seems that the present method is wrong in that it is based upon a system of accounting which considers the obsolescence of equipment with a purpose of accumulating a surplus to protect the stockholders when the equipment gets out of date, instead of considering that the car has a "service value" so long as it will run. For example, there are two cars in service today, just as valuable as the day they were built, which were the first steel cars put into service. Their actual scrap value is in excess of the 40 per cent of the original value which the rules will permit to be charged if they are destroyed on foreign lines.

Therefore, these cars, now 22 years old, are just as valuable from the Transportation standpoint as if they were only 2 years old. Yet the road which destroys them can dismantle the scrap and sell it and pay the owner under the M. C. B. Rules and have an actual profit.

The price per pound of all classes of cars is near enough alike that one price could be established which would be close to the average value of any particular car. And that price should be the price of replacement, not the cost when new or an arbitrary price based upon conditions when the car was built.

These changes would have been proper years ago, they are especially desirable now when all our energies are necessary to the successful carrying on of a great war.

## THE DESIGN OF OFFSET BEAMS

BY VICTOR M. SUMMA
Engineering Examiner, American Brake Company

In designing it is often necessary to offset certain members to secure the required clearance. This introduces stresses which are not found in straight members. Where the offsets are large the section at the bends is sometimes increased, however, many cases can be found where the strength has been greatly reduced without a corresponding increase in the section being made. Even where the section is increased it is often done unscientifically. In view of the apparent lack of knowledge of the proper methods of

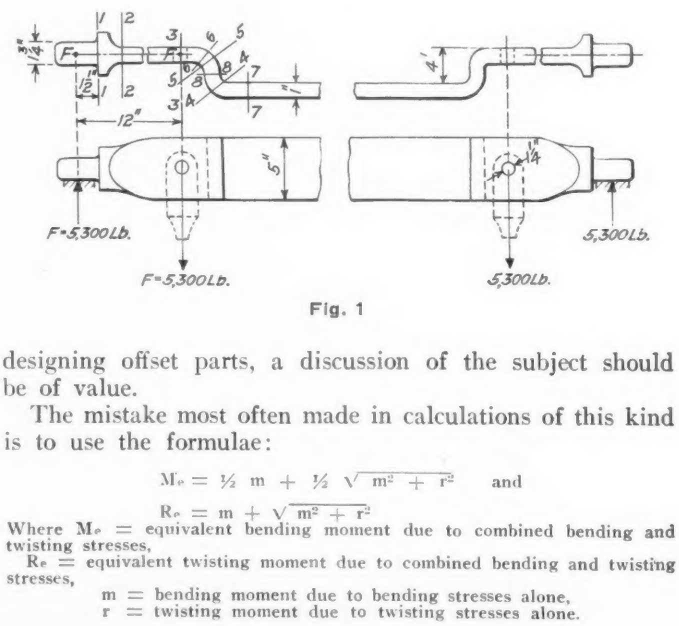



Fig. 1

designing offset parts, a discussion of the subject should be of value.

The mistake most often made in calculations of this kind is to use the formulae:

$$M_e = \tfrac{1}{2}\, m + \tfrac{1}{2} \sqrt{m^2 + r^2} \quad \text{and}$$

$$R_e = m + \sqrt{m^2 + r^2}$$

Where $M_e$ = equivalent bending moment due to combined bending and twisting stresses,
$R_e$ = equivalent twisting moment due to combined bending and twisting stresses,
$m$ = bending moment due to bending stresses alone,
$r$ = twisting moment due to twisting stresses alone.

These formulae apply to circular sections only. For non-circular sections it is necessary to use the general equations

$$T = \tfrac{1}{2} p + \sqrt{v^2 + \tfrac{1}{4} p^2} \quad \ldots\ldots (1)$$

$$S = \sqrt{v^2 + \tfrac{1}{4} p^2} \quad \ldots\ldots (2)$$

Where T = maximum tensile or compressive unit stress
S = maximum shearing unit stress
p = applied tensile unit stress
v = applied shearing unit stress

These expressions can be applied regardless of the shape of the section or the manner in which the stresses are pro-

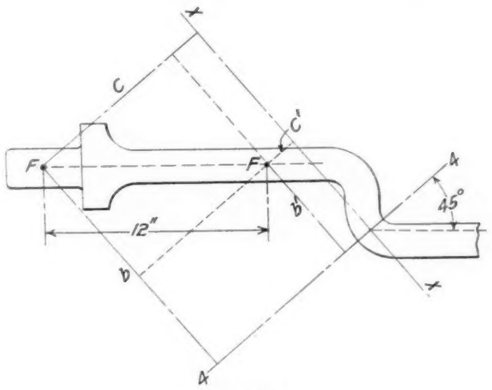



Fig. 2

duced, as the relations hold good for all cases where the tensile or compressive stress, $p$, and the shearing stress, $v$, act at right angles to each other.

For purposes of illustration the design of an offset brake beam will be considered. The beam shown in Fig. 1 failed in service, so an investigation of the stresses in various sections will be of interest. The two pull rods, each of which transmits a maximum force of 5,300 lb., are attached 12 in. from the centers of the trunnions which also bear a pressure of 5,300 lb. The center portion of the beam is of a rectangular section 1-in. by 5-in. and has a 4-in. offset. Sections (1-1), (2-2) and (3-3) are subjected to plain bending and the unit stresses at these points are readily ascertained by the usual method, but sections (4-4), (5-5) and (6-6) have to resist shearing stresses due to the torsional moment besides the tensile or compressive stresses set up by the bending moment, and the stresses in these sections are not so easy to determine.

The diagram in Fig. 2 shows the forces acting on section 4-4, which make an angle of 45 deg. with the horizontal. The lines x-x and 4-4 represent the axes respectively of the

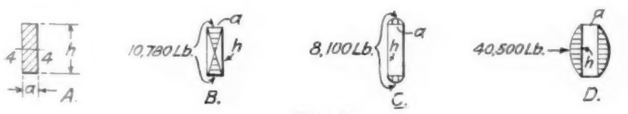



Fig. 3

polar modulus or modulus of the section for torsion $Zp$, and the rectangular modulus or modulus for bending $Z$. The two forces $F$ are equal and act in opposite directions, both being in lines perpendicular to the plane of the paper. Let $b$ and $b'$ represent the distances of these forces from the axis 4-4 and $c$ and $c'$ their distances from the axis x-x. Let $M$ be the bending moment and $R$ the twisting moment due to these forces.

Then $M = Fb - Fb^1 = F(b\text{-}b^1) = F \times 12 \times \sin 45°$
$R = Fc - Fc^1 = F(c\text{-}c^1) = F \times 12 \times \cos 45°$
$\sin 45° = .707 \qquad \cos 45° = .707$

Therefore $M = R = 5{,}300 \times 12 \times .707 = 45{,}000$ inch pounds. Also $M = pZ$, where p = maximum unit stress in tension or compression; Z = modulus of section in tension or compression (for rectangular section $Z = \frac{ah^2}{6}$) (See Fig. 3a)

$$p = \frac{M}{Z} = \frac{45{,}000 \times 6}{1 \times 5^2} = 10{,}800 \text{ lb. per sq. in.}$$

The tensile or compression stresses are of course greatest at the edges and decrease toward the neutral axis where they are zero. The distribution of stresses is shown in Fig.

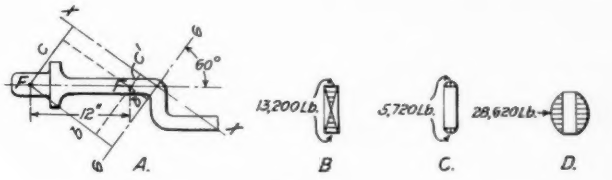



Fig. 4

3b, the width of the shaded portion indicating the magnitude of the unit stresses.

To find the maximum shearing stresses use the formula:

$$R = v\,Zp \text{ or } v = \frac{R}{Zp}$$

Where v = unit shearing stress
Zp = modulus of section in shear (for rectangular sections $Zp = \frac{2}{9} a^2 h$ or $\frac{2}{9} a h^2$)

$$v = \frac{R}{Zp} = \frac{45{,}000 \times 9}{2 \times 1 \times 5^2} = 8{,}100 \text{ lb. per sq. in.}$$

$$= \frac{45{,}000 \times 9}{2 \times 5 \times 1^2} = 40{,}500 \text{ lb. per sq. in.}$$

On any side of a rectangle the shearing stress is greatest at the middle and varies approximately as the ordinates of a parabola toward each corner where it becomes zero. The

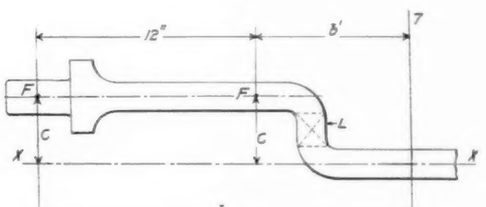



Fig. 5

stress at the middle of the broad side is greater than at the middle of the short side (see Fig. 3c and 3d).

It will be seen that the maximum stresses are 40,500 lb. per sq. in. in simple shear occurring at the middle of side $h$, and those resulting from the combination of 10,780 lb. per sq. in. tension or compression and 8,100 lb. per sq. in. shear at the middle of the shorter side, $a$. As the lines of action of these stresses are at right angles, we can find the resultant forces by using formulae 1 and 2 given above.

From (1) $T = \frac{10{,}800}{2} + \sqrt{8{,}100^2 + \frac{10{,}800^2}{4}} = 15{,}140$ lb. per sq. in. in tension or compression.

(2) $S = 9{,}740$ lb. per sq. in. in shear.

These may be considered the greatest combined stresses in the section. The shearing stresses at the center of the

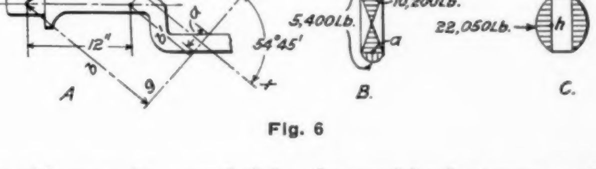



Fig. 6

long side may be exceeded by the combined stresses a short distance on either side of the center, but for all practical purposes these stresses can be neglected.

It is evident that since the angle which the section 5-5

makes with a horizontal plane is 45 deg., the stresses just found for section 4-4 will apply to it also, as the moments will be the same as those about section 4-4.

The next section to be considered is section 6-6 which makes an angle of 60 deg. with the horizontal. The stresses are shown in the diagram, Fig. 4a. In this case,

$$\begin{aligned} M = F\ (b\text{-}b^1) &= F \times 12 \times \sin 60^\circ \\ &= 5{,}300 \times 12 \times 0.866 \\ &= 55{,}000 \text{ in. lb.} \\ R = F\ (c\text{-}c^1) &= F \times 12 \times \cos 60^\circ \\ &= 5{,}300 \times 12 \times 0.5 \\ &= 31{,}800 \text{ in. lb.} \end{aligned}$$

$$p = \frac{55{,}000 \times 6}{1 \times 5^2} = 13{,}200 \text{ lb. per sq. in.}$$

$$v = \frac{31{,}800 \times 9}{2 \times 1 \times 5^2} = 5{,}720 \text{ lb. per sq. in.} \quad \text{or}$$

$$v = \frac{31{,}800 \times 9}{2 \times 5 \times 1^2} = 28{,}620 \text{ lb. per sq. in.}$$

(See Fig. 4, b, c and d)

It is necessary to find the resultant of the tensile or compressive and shearing stresses at the middle of the short side, as in the section 4-4

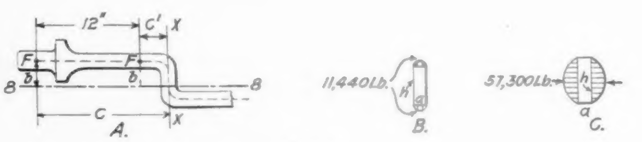



Fig. 7

$$T = \frac{13{,}200}{2} + \sqrt{5{,}720^2 + \frac{13{,}200^2}{4}} = 15{,}350 \text{ lb. per sq. in., in tension or compression.}$$

$S = 8{,}750$ lb. per sq. in. in shear.

The next section to be investigated is 7-7. (see Fig. 5.) In this case

$$M = F\ (b\text{-}b^1) = F \times 12 = 5{,}300 \times 12 = 63{,}600 \text{ in. lb.}$$

$$p = \frac{63{,}600 \times 6}{1 \times 5^2} = 15{,}150 \text{ lb. per sq. in.}$$

$$R = F\ (c\text{-}c) = 0$$

It will be seen that in section 7-7, normal to the axis x-x, there are only bending stresses. The equations for $M$ and $R$ show not only that these stresses are constant between the two middle bends, but also that they are not greater than the stresses in a straight beam, provided that the depth of the offset is not enough to cause any appreciable distortion of the beam, due to the torsional stresses in the vertical portion, $L$, marked with a dotted cross in Fig. 5.

Due to the method of loading, it is possible that some sections like 9-9 (see Fig. 6a) making an angle with the

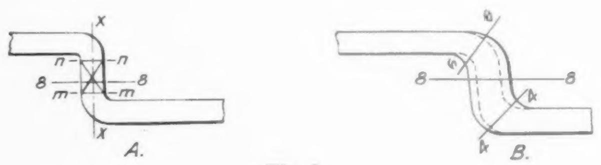



Fig. 8

horizontal, may develop shearing stresses greater than the section can withstand. It is evident that the bending stresses will not be greater than in section 7-7. The point at which the shearing stresses are greatest can be determined from the general equation for these stresses by differential calculus or by making complete calculations for sections at various angles. In this case it is found that the maximum shearing stress occurs in a section making an angle of 54 deg. 45 min. with the horizontal axis. The shearing unit stress at the middle of the long side of the section is 22,050 lb. per sq. in. and at the middle of the short side 5,400 lb. per sq. in. The maximum combined tensile and shearing unit stresses at the center of the short side of the section are 12,500 lb. per sq. in. and 12,250 lb. per sq. in. respectively. As the shearing stresses should not exceed 20,000 lb. per sq. in. the section should be increased to say 1⅛ in. by 5 in.

We will now consider section 8-8 (see Fig. 7a). Here

$$\begin{aligned} M &= F\ (b\text{-}b) = 0 \\ R &= F\ (c\text{-}c^1) = F \times 12 \\ &= 5{,}300 \times 12 = 63{,}600 \text{ in. lb.} \end{aligned}$$

In other words this is just the converse of section 7-7, as in this section there are only torsional stresses. The unit stresses are as follows:

$$v = \frac{63{,}600 \times 9}{2 \times 1 \times 5^2} = 11{,}440 \text{ lb. per sq. in.}$$

$$v = \frac{63{,}600 \times 9}{2 \times 5 \times 1^2} = 57{,}300 \text{ lb. per sq. in.}$$

The values of $M$ and $R$ will not change though section 8-8 is taken at any point between n-n and m-m (see Fig. 8a) and since the section between these points is uniform, the unit stresses must be the same. Of course a shearing stress of 57,300 lb. per sq. in. is far beyond the safe limits, as the ultimate shearing strength of wrought iron is only about 40,000 lb. per sq. in. Failure was therefore bound to occur in the vertical section of the beam.

Assuming that the stresses should not exceed 20,000 lb. per sq. in. in either tension or shear, the next problem is to find the dimension of side $a$, at the sections 4-4, 6-6 and 8-8 required to limit the stresses to this value, the width remaining 5-in. Let $x_4$, $x_6$ and $x_8$ be the required

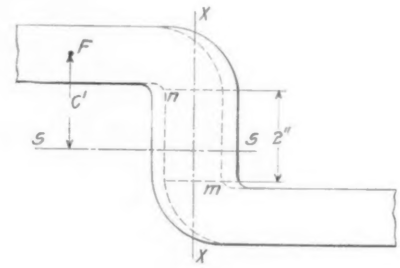



Fig. 9

thicknesses at these sections. Referring to the calculations for the stresses in section 4-4 we find

$$v = \frac{45{,}000 \times 9}{2 \times 5 \times 1^2} = 40{,}500 \text{ lb. per sq. in.}$$

Substituting the required value of 20,000 for $v$ and $x_4$ for $l$, we have,

$$20{,}000 = \frac{45{,}000 \times 9}{2 \times 5 \times x^2}$$

$$\text{or} = \sqrt{\frac{45{,}000 \times 9}{2 \times 5 \times 20{,}000}}$$

$$x_4 = 1.42 \text{ or } 1\ 7/16 \text{ in.}$$

Similarly

$$x_6 = \sqrt{\frac{31{,}800 \times 9}{2 \times 5 \times 20{,}000}} = 1.2 \text{ or } 1\ 3/16 \text{ in.}$$

$$x_8 = \sqrt{\frac{63{,}000 \times 9}{2 \times 5 \times 20{,}000}} = 1.68 \text{ or } 1\ 11/16 \text{ in.}$$

The shape of the section with these required dimensions is shown in Fig. 8b.

It is necessary to ascertain the angular deflection of the vertical portion of the beam, (m-n in Fig. 9) in order to determine whether the beams will be unduly distorted under the action of the maximum stresses. To find the angular deflection, use the formula

$$\phi = \frac{205\ M_t\ l\ (a^2 + l^2)}{a^3\ h^3\ G}$$

Where

$\phi$ = angle of deflection in degrees.

$M_t$ = twisting moment, in inch-pounds.

$l$ = length of section subjected to twisting moment, in inches.

G = modulus of elasticity for shear, generally taken as 10,500,000 for wrought iron.

$$\phi = \frac{205 \times 5300 \times 12 \times 2 \times (1.68^2 + 5^2)}{1.68^3 \times 5^3 \times 10,500,000} = \frac{726,000,000}{6,210,000,000} = .1165 \text{ deg.}$$

Evidently this slight angular deflection will be of no consequence, and the beam as designed has ample stiffness.

## RAILROAD ADMINISTRATION'S PAINT ORDERS

The car builders have been authorized by the Central Advisory Purchasing Committee to purchase all the painting materials (except wood preservative) for painting the cars they are to build for the U. S. Railroad Administration, at prices not to exceed the following:

Reinforced Red Lead Semi-paste Paint (Spec. R-810), $2.40 per gallon, f. o. b. factory.
Dark Red Oxide Semi-paste Paint (Spec. R-812), $1.40 per gallon, f. o. b. factory.
Black Semi-paste Paint (Spec. R-811), $1.65 per gallon, f. o. b. factory.
Stencil Black Paste Paint, $0.10½ per pound, f. o. b. factory.
Stencil White Paste Paint, $0.11⅜ per pound, f. o. b. factory.
Thinning Mixture (Spec. R-822-A), $0.83 per gallon, f. o. b. factory.

A list of the paint manufacturers agreeing to furnish paint at these prices may be had on application to the committee.

The builders are expected to purchase the paint at a price lower than the maximum figures named, if they can, taking into consideration sureness of supply, shortest haul and least congested routes. They are also advised that by spreading deliveries over an extended period they may also be able to obtain lower prices. Copies of all orders must be sent to the Inspection and Test Section and to the Procurement Section.

The above instructions to the carbuilders are of particular interest because they indicate in great measure the policy that is being followed out by the Procurement Section to allow the carbuilders to use their own organizations and established practices in the matter of purchasing and procuring material, thereby securing the advantages of the familiarity which these departments have with the purchasing of supplies.

A copy of the specifications for reinforced red lead semi-paste paint (R-810) and black semi-paste paint (R-811) are given below:

### REINFORCED RED-LEAD SEMI-PASTE PAINT

*Locomotives and Cars*

R-810

1. *General Specifications.*—General specifications for paint and painting materials, issued by the Railroad Administration, in effect at date of opening of bids, shall form part of these specifications.

2. *Composition.*—The grinding proportions shall be:
   Pigment, 82 per cent.
   Liquid, 18 per cent.

The pigment portion shall consist of:
   Red lead, not less than 65 per cent.
   The remainder shall be silicious matter, such as aluminum silicate, magnesium silicate, silica, or a mixture thereof.
   The red lead shall contain not less than 85 per cent true red lead ($Pb_3O_4$), the remainder to be litharge ($PbO$).

The liquid portion shall consist of raw linseed oil.

3. *Special Requirements.*—The semi-paste paint shall weigh not less than 22 pounds per gallon. When mixed with the thinning mixture in the proportion of 2 volumes of semi-paste to 1 volume of Standard thinning mixture, the resulting mixture applied to a smooth metal surface shall dry in 10 hours with an oil gloss.

### BLACK SEMI-PASTE PAINT

*Locomotive and Cars*

R-811

1. *General Specifications.*—General specifications for paint and painting materials issued by the Railroad Administration, in effect at date of opening of bids, shall form part of these specifications.

2. *Composition.*—The grinding proportions shall be:
   Pigment, 50 per cent.
   Liquid, 50 per cent.

The pigment portion shall consist of:
   Lampblack, not less than 20 per cent.
   Red lead, not less than 5 per cent.
   The remainder shall be shale black, aluminum silicate, magnesium silicate, or a mixture thereof.
   The lampblack shall be of such quality as to produce the standard color, and shall not contain more than 2 per cent of ash.

The liquid portion shall consist of raw linseed oil.

3. *Special Requirements.*—The semi-paste paint shall weigh not less than 10 pounds per gallon. When mixed with the thinning mixture in the proportion of 1 volume of the semi-paste to 1½ volumes of the Standard thinning mixture, the resulting mixture applied to a smooth metal surface shall dry in six hours with an oil gloss.

### PAINTING AND LETTERING FREIGHT CARS

The regional director of the eastern region has issued the following instructions governing painting and preservation of identity marking on freight car equipment, to become immediately effective:

1. The preservation of freight car equipment of all railroads under Federal control will be maintained by necessary repainting and restenciling. When paint on freight equipment cars has become perished to the extent of permitting the steel to rust and deteriorate, or the wood to become exposed to the weather, they should be repainted. The car body (including roof) should be entirely repainted if, for any cause, it is found necessary to paint one-third or more of the car. Before applying paint to steel, it should be scraped and cleaned off with wire brush; wood parts should be scraped so as to clean off all blisters and loose paint, including removal of protruding nails and tacks.

2. The station marking showing where car was last reweighed should not be changed unless the car is reweighed.

3. When repainting freight equipment cars, two coats will be applied to all new parts and old parts of body which have been reworked causing removal of paint. One coat will be applied to parts where old paint is in good condition. Should the old paint be found in such condition requiring two coats, they may be applied.

4. The stenciled letters and numbers on all freight equipment cars will be maintained and identity kept bright. When the lettering or numbering is found in bad condition, renew the identity by either repainting the car or by applying new stenciled letters and numbers. In selecting cars for this purpose, preference should be given those on which the marking and painting is in the poorest condition.

5. If there is not sufficient paint on car to properly retain the new stenciling, and condition of car does not justify entire repainting, one coat should be applied as a panel back of the stenciling, so that the paint used in applying the numbers and letters will hold; otherwise, the marking applied will soon become illegible and make it necessary to again apply the identity marking within a short period.

6. Detention of equipment from service for painting should be avoided when possible. A great deal of this work can be done to open cars in transportation yards when under load in storage.

## WHY DON'T DADDY COME?*

BY O. D. BOYLE
Yard Brakeman, Baltimore & Ohio, Washington, D. C.

When the Baltimore & Ohio organized its first safety committees several years ago, I had the honor of representing the employees in train service at this terminal. I entered the work with an enthusiasm that grew into elation when the succeeding monthly charts showed a surprisingly large reduction in the number of preventable accidents. Yet, while I was preaching Safety to my fellows, I was not practicing it myself—I could not resist the temptation to take a chance occasionally. As I look back I can see that my work for Safety was a hollow proposition; merely a question of making a "good record."

But a new epoch in my "Safety First" education was reached when God sent us Helen. She has been with us almost three years now, so, of course, by this time we are very well acquainted. She is not yet old enough to understand the general scheme of life, but she is fully conscious of the fact that I must leave her every morning "'cause your train's awaitin' for you," and that I should come back to her "sometime after the sun's gone to bed." And what a time for her when "Daddy" does come home! I have just rung the bell—I can't see her yet, but I can hear her joyous cry, "Daddy's home! daddy's home!" and a rush of eager feet across the room. Oh yes, I see her now running through the hall—

*Reprinted from the Baltimore & Ohio Employees' Magazine.

mamma opens the door—a jump into my ready arms—a squeeze—a smack—"So glad you've come, daddy!"—and then an evening of joy.

She is not yet old enough to understand about derailments, engine failures, congested yards or a thousand other things that sometimes occur on the best regulated railroads, so that when I happen to be the "goat," it is the cause of many troubled moments to the precious little mind and the source of many anxious queries to her mother—"Why don't daddy come?"

Ah! "Why don't daddy come?" Suppose daddy never comes! Suppose the anxious waiting moments are turned into an unbroken vigil of days—months—years! Could a million dollars' insurance erase the yearning of the little troubled heart? Could all of the great lawyers in this land make her understand when, with her anxious face turned up to meet the tear-dimmed eyes of her mother, she asks, "Why don't daddy come?"

No! That's why I stopped going between moving cars at the last moment, to adjust the knuckle. That's why I stopped kicking couplers. That's why I stand on the outside of the rail when boarding my engine. That's why I am extra careful in walking over the top of my train in bad weather. That's why I inspect my train at every opportunity. That's why I work with an absolute conviction that if I don't go home to Helen tonight it will be because of the will of God or the carelessness of you, fellow-worker.

To the will of God I can only say, "Be merciful. Thy will be done."

But of you fellow-worker, I ask "Would you rob my child?" Certainly you would not take her candy, her doll, her house or her little iron bank. Assuredly not! Yet if you did, they could be replaced.

Again, I ask you, "Would you strike my child?" No! Yet if you did, it would soon be forgotten.

Now, I ask you, "Would you rob her of her daddy? Would you strike her little heart a blow that would never be forgotten?"

Then the next time you see a loose handhold, chalk it, so that I can notice it when grabbing for it; the next time you see an obstruction near the track, remove it, so that I won't fall over it when switching; if you see a switch point which does not fit tight report it so that my train won't pick it open; if you find a switch light out, fix it so as to protect my train when I come along; if your train stops, go back to flag just a little bit further, so as to be doubly sure my train won't be wrecked; if you find a bad section of track, repair it today, so that my train won't spread the rails when it reaches it; if you can remedy any unsafe condition or practice and make my occupation a little less hazardous, do it. I do not ask it for myself. I can stand the shock of losing a limb and, with God's help, I do not fear death. But—

Helen will be waiting for me tonight, and tomorrow night and every night and I don't want her unanswered when she anxiously asks—"Why don't daddy come?"

### *SOME OF THE DANGEROUS PRACTICES WHICH PREVENT DADDY GETTING HOME SAFELY*

*When we leave cars too close to a switch to clear a man on the side of a car on the adjoining track.*

*When we leave drawbars, material and other movable obstructions too close to the track.*

*When we leave boards with nails sticking up for ourselves or some one else to step on.*

*When we fail to put out a blue flag when under cars repairing or inspecting them.*

*When we refuse to wear goggles.*

*When we use defective and burred tools.*

*When we kick drawbars over just as cars are coming together.*

*When we throw away guards on emery wheels and gearing of machines.*

*When we do not keep a lookout for moving cars or engines while working about trains.*

*When we move cars on loading tracks without first requiring occupants to get out.*

*When we find a loose grab iron, ladder rung or a bad order coupler and fail to fasten a red tag to it so that the next man will be warned and the necessary repairs made.*

*Why not cut out these dangerous practices and stop working for the doctor and undertaker and keep ourselves whole and sound for the benefit of the wife and kids?*

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**Camouflaged Freight Cars for Carrying Munitions to the Front in France**

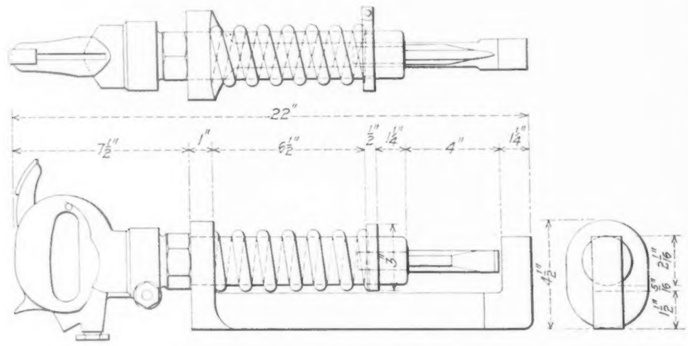
# SHOP PRACTICE

## AIR HAMMER ATTACHMENT

BY J. S. BREYER
Master Mechanic, Southern Railway, Charleston, S. C.

The air hammer attachment shown in the illustration is for use in splitting nuts on grab irons and ladders when dismantling cars for heavy repairs.

The device consists of a piece of 1-in. square iron forged at one end and in the shape of a yoke around a hammer, and at the other end bent at 90 deg. as indicated. Near the end of the barrel of the air hammer there is a collar which fits



Nut Splitting Attachment for Thor Hammer

into a groove ½-in. wide by ⅛-in. deep, and is the stop for a 3/16-in. coil spring. The purpose of this spring is to hold the hammer and chisel against the yoke, and as the yoke fits closely around the barrel of the hammer, there is no danger of the chisel shooting out and causing an accident.

In operation, the end of the yoke, which is bent to an angle of 90 deg., is hooked around one side of the nut and the chisel brought to bear on the opposite side. The air hammer trigger is then pressed, which operates the chisel and very quickly splits nuts up to ⅝ in. in size.

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## AN EFFICIENT MACHINE FOR FINISHING CROWN STAYS

The finishing of crown stays is a job for which standard types of machines are not well adapted. Cutting the thread under the head of the stay requires considerable time with the ordinary arrangement. To overcome this difficulty the Columbus, Ohio, shops of the Pennsylvania Lines have constructed a special machine for finishing crown stays. This device, which was converted from an early make of Jones & Lamson flat turret lathe, is shown in Fig. 1. The principal features of the device are the tool for forming the head and the box tool for turning the end of the stays, which are mounted on a slide on the turret carriage, and a split self-opening die mounted on a swinging arm.

The forming tool which finishes the space under the head, is carried in a holder which has an eccentric to bring it into the cutting position, or to hold it away from the work. The outer end of the slide carries a centering guide and a box tool, which is adjustable to various sizes. The split die carries the usual set of four chasers and also a nicking tool operated by a lever, which is used to form a recess under the head of the stay. The details of construction of the die head are shown in Fig. 2. The usual mechanism for

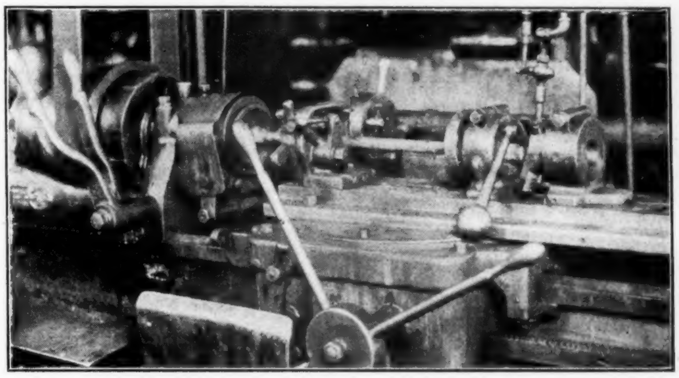
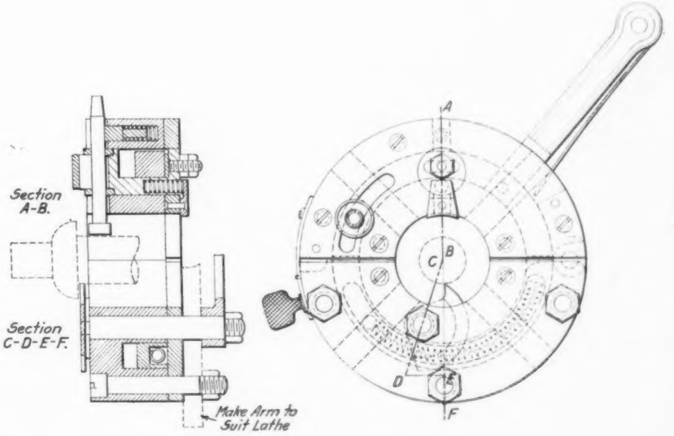


Fig. 1—Turret Lathe Fitted up for Finishing Crown Stays.

closing, locking and tripping the die is used. The body is fitted with a hinge so that it may be opened and passed over the stay. On the side opposite the hinge is a spring latch for holding the die in the closed position. The ring, fitted with cams which hold the cutters in place, is parted to bring the ends of the two halves at the dividing line of the body when the chasers are in the open position.



No. 2—Details of Hinged Self-Opening Die.

When finishing crown stays on this machine the position of the box tool is adjusted on the slide, so that the cut on the large end will be completed at about the same time that the forming tool begins to face the head. The head of the stay is slipped through the holder for the forming tool and placed in the chuck, the outer end is run through the cen-

tering guide and the cut is started with the box tool. The forming tool is placed in the cutting position and the head is shaped. As soon as these two cuts are finished the carriage is moved back until the end of the stay rests in the centering guide. The arm carrying the split die is swung forward into position as shown in Fig. 3. The recess is

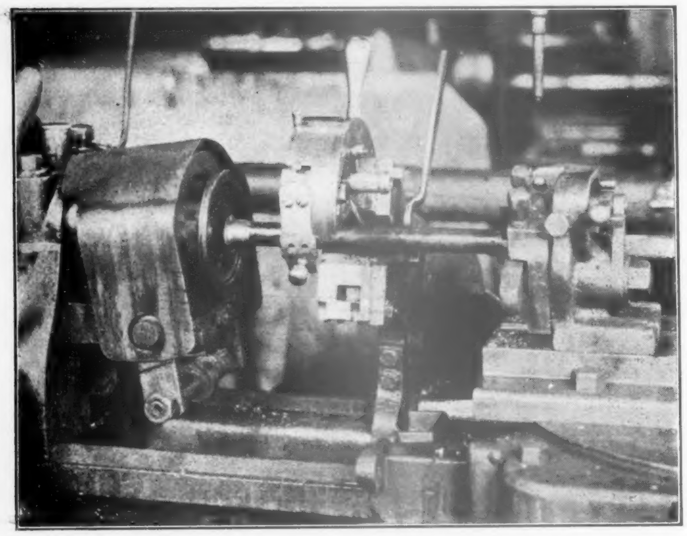


Fig. 3—Die Swung in Place over Crown Stay, Open Position.

cut under the head with the nicking tool and the thread is chased. The crown stay is then removed from the machine and the outer end is threaded on a bolt cutter. The entire operation on this machine is finished in a minute and a half.

## WELDING FIREBOX PATCHES AND CRACKS

BY E. D. JOHNSON

A great deal of trouble has been experienced in welding firebox patches by either the electric or oxy-acetylene process. It is very difficult to provide for the expansion and contraction in welding straight seams. Often the welder looks his work over admiringly when it is finished and before he gets out of the firebox the contraction causes the seams to break. After experimenting with patches of va-

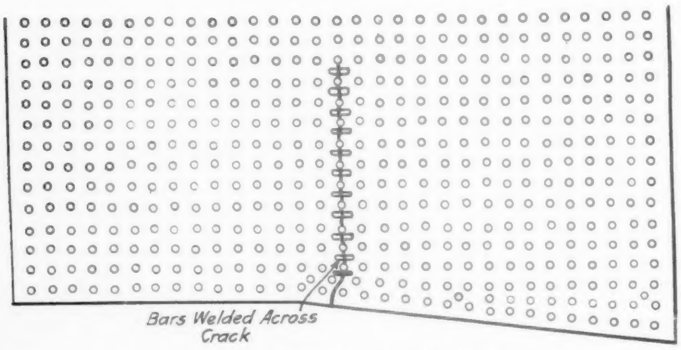



Fig. 1—Method of Reinforcing Welded Cracks

rious shapes in an endeavor to overcome the trouble, I have found what I call the serpentine patch to be the best.

This type of patch is laid out as shown in Fig. 2. The seams in the stayed surface do not extend in a straight line for more than 12 in. at any point. It is almost always possible to lay out a patch in this way by alternating the seams between different rows of staybolts. The expansion and contraction of the sheet does not cause any trouble where this arrangement is used. Patches made in this way have been in service for three years and have required no attention during that time. When welding in patches it is best to build the weld up flush with the sheet for 6 or 8 in., then brush off the oxide which forms with a wire brush and reinforce the weld with not more than 1/16 in. of metal. No more should be applied because an excessive amount added to the weld results in over-heating when the locomotive is in service.

As a rule it is best not to weld cracks over 10 in. long, but where necessary longer cracks can be welded successfully

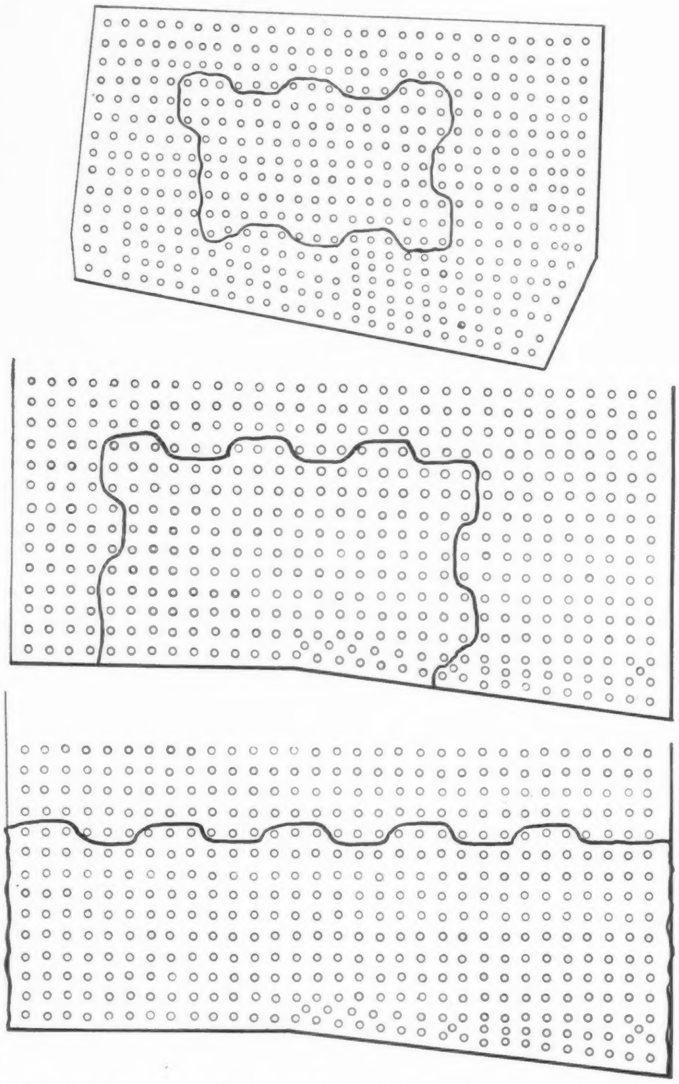


Fig. 2—Serpentine Seams as Applied to Patches and Half Side Sheets

by building the weld up flush with the sheet, then cutting transverse grooves two or three inches apart as shown in Fig. 1, laying ¼-in. steel rods in the grooves and welding over them for the entire length. In this way the sheet is made stiffer and in addition the rods must be broken before the weld can crack.

MACHINE FOR COLLECTING BARBED WIRE SCRAP.—Among the novelties produced by the war is a machine invented by Thomas Marshall, of Stanningley, England, for collecting barbed wire scrap in war-destroyed areas. The machine, which has a remote resemblance to a straw and hay elevator, is carried on caterpillar chain tracks. The wire scrap is picked up and cut into lengths and then dumped into cars or pressed into bales.—*The Engineer, London.*

# Milling Practice in Railway Shops

**Interesting Examples of Cutters Used with Success at the Southern Pacific Shops in Sacramento, Cal.**

BY FRANK A. STANLEY

OWING, undoubtedly, to the wide-spread and early adoption of the planer, shaper and slotter in railroad shop practice, and also to the fact that a great deal of the work handled in the railway shop is necessarily of a special class with comparatively few duplicate pieces to be made at one time, there has been less development of the use of the milling machine in such places than in many other classes of manufacturing and repair shops. This has been true in spite of the fact that today the milling machine with its facilities for holding work of all kinds and its possibilities as a rapid tool for machining any kind of work to which a rotary cutter can be applied, is essentially a general purpose machine which has its legitimate field not only in the high production factory where parts are manufactured in great quantities but also in repair and general machine shops where perhaps only a few pieces of a kind are ever put through in one lot.

Because of the restricted uses to which the miller as a rule has been applied in the railroad shop there has been less advance in the development of milling cutters in such establishments than is desirable and this has done much toward retarding the extension of the machine itself as a most useful factor in the handling of many operations therein. For the machine to be effective it must be equipped with suitable cutters, cutters having teeth of coarse pitch and ample chip space between the teeth, they must be capable of taking a very heavy chip when used on a machine of rigid design and ample pulling power. Milling machine design and the design of cutters by regular manufacturers have in a sense kept pace with each other and the shops equipped with suitable machines and with correspondingly good cutters derive the full benefits of milling, whether gaged by the quantity of work produced, the quality of the work, or both.

### COMMON TROUBLES WITH CUTTERS

It is a common fault to grind milling cutters too small in diameter and their teeth of too fine a pitch, leaving insufficient space for the chips between them and causing too many teeth to be in contact with the work surface at one time. The teeth will not have a free cutting action and both the cutter and the work will be unduly heated. This condition is still further aggravated by an unsatisfactory flow of lubricant for cooling and clearing the teeth and work. The cutter is sometimes carried on too light an arbor for smooth operation, the springing of the cutter under these conditions producing a chatter on the work surface which is made more pronounced when the work is improperly supported or because of weakness in the design of the machine. The cutter teeth are sometimes milled straight across the face, that is parallel to the axis, when in many instances and particularly with broad faced slabbing or surfacing mills far better results would be secured by a helical or spiral form of tooth which because of its shearing action upon the work surface would give an easier, smoother cut.

### ADVANCE IN CUTTER PRACTICE

Some interesting practices in cutter making and modern milling methods are to be found at the Southern Pacific shops at Sacramento, California. At this place a good many classes of work are regularly handled on the milling machine with most satisfactory results and one of the principle functions of the tool room staff is the production and maintenance of milling cutters.

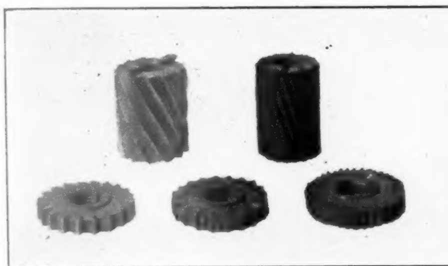


Fig. 1—Cutter Tooth Proportions

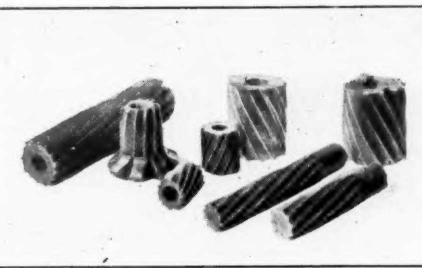


Fig. 2—A Group of Modern Cutters

Fig. 3—Old and New Shank Mills

*Comparison of Cutter Teeth.*—A few illustrations will serve to show the improvement found in the form and number of teeth now used in the milling cutters at this shop.

Fig. 1 shows at a glance the improved practice in tooth form and character as exemplified by two ordinary sizes of cutters, one a plain mill about 6 in. long by 4½ in. diameter, the other a side or straddle mill of about the same diameter with a face of 1½ in. The two cutters at the right in this view are of the old design with closely spaced, fine teeth. The three cutters to the left in the group are of the type now made for some years back at this place but only too seldom seen in use even today in the general run of shops.

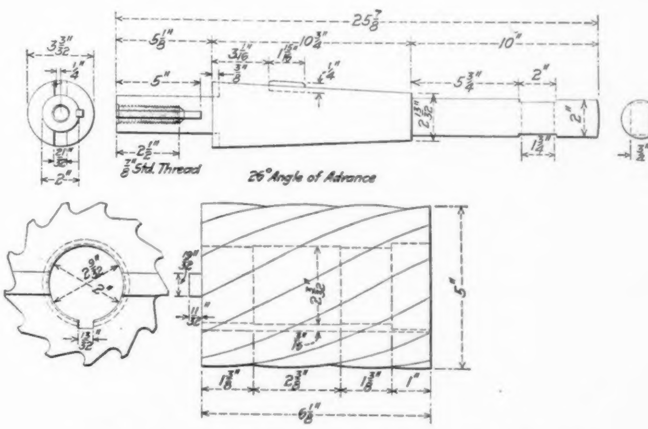



Fig. 4—Details of Milling Cutter for Vertical Machine

The old form of side cutter shown was made with 40

teeth for this diameter and obviously the spacing between teeth is insufficient to permit of economical rates of speed and feed and of satisfactory clearance for chips. Furthermore, as such a cutter becomes worn down and is recut for future service, the objectionable feature of fine tooth pitch becomes even more marked, that is, it increases in direct ratio to the reduction in diameter and the ultimate life of the cutter is materially shortened.

*Coarse Pitch Examples.*—With the newer, coarse tooth cutters referred to there are only 20 teeth for the same diameter and all of the advantages of properly proportioned cutting teeth and clearance space are accordingly secured. The differences in tooth characteristics between the fine and

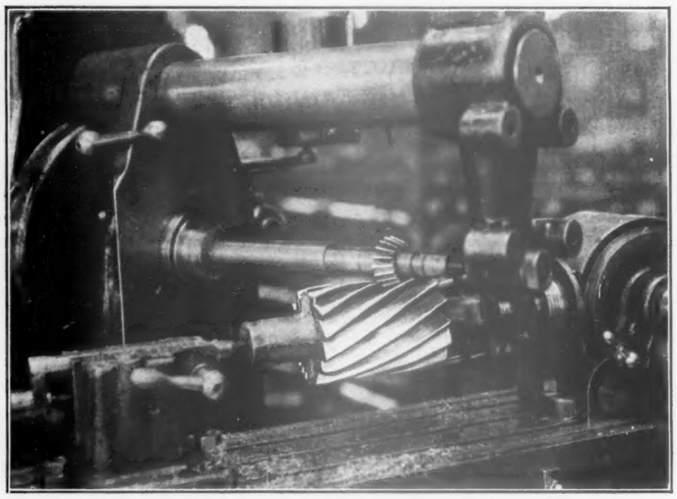


Fig. 5—Recutting a Worn Milling Cutter

coarse pitch cutters are even more conspicuously brought out upon comparison of the two spiral cutters at the rear of the group in Fig. 1, where the older example at the right is provided with 22 teeth while the later cutter at the left has only 13 teeth.

This feature of coarse teeth has been adhered to in all classes of cutters made here. For instance, note the various examples in Fig. 2 where several distinctive types of cutters,

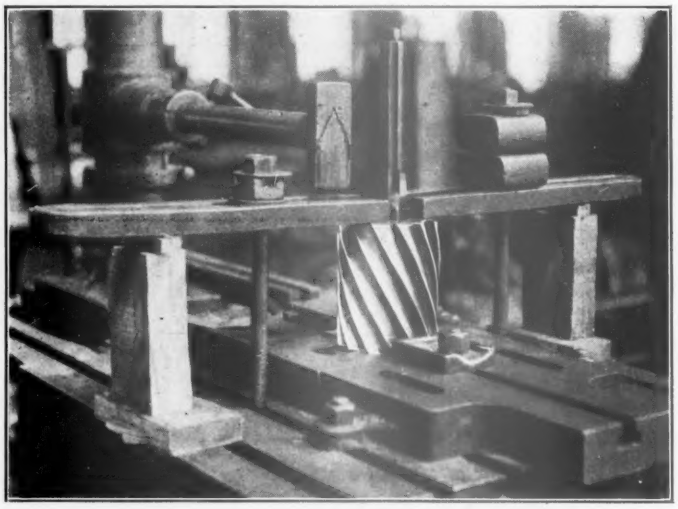


Fig. 6—Putting Arbor Keyway in Cutter

large and small, are grouped together, all with liberal spacing between teeth. And, for another illustration in the way of comparison of coarse and fine pitch, note also the four mills in Fig. 3, all nominally 2 in. in diameter, with the two at the right cut with very coarse teeth and sharp angle of helix, while the other two are of the old design with teeth so closely spaced as to become ineffectual after they have been ground down to a limited extent. The respective working qualities of the two kinds of cutters are too apparent to require special comment at this moment.

*Details of Cutter Proportions.*—The coarse toothed cutters have become established tools at these shops,

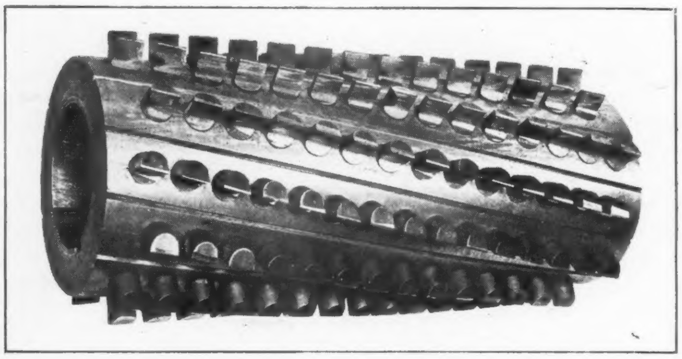


Fig. 7—Large High Speed Steel Milling Cutter

and it may be of interest here to show details of one size of cutter which has already been noted in relation to the groups in Figs. 1 and 2. This particular form of cutter is used on a heavy vertical spindle milling machine and its dimensions as well as the proportions of its arbor are covered by the drawing shown in Fig. 4. The cutter is $6\frac{1}{8}$ in. long by 5 in. diameter. It has 13 teeth cut to an advance angle of 26 deg. or one turn in 30 in. The teeth are cut with a 70 deg. milling cutter, to a depth of $\frac{3}{8}$-in. and are provided with a 7/32-in. fillet at the bottom. The gap between teeth will amount to about $2\frac{1}{4}$ cu. in. for each tooth; thus ample chip space is provided for heavy milling operations. The bore of the cutter where it fits the arbor is

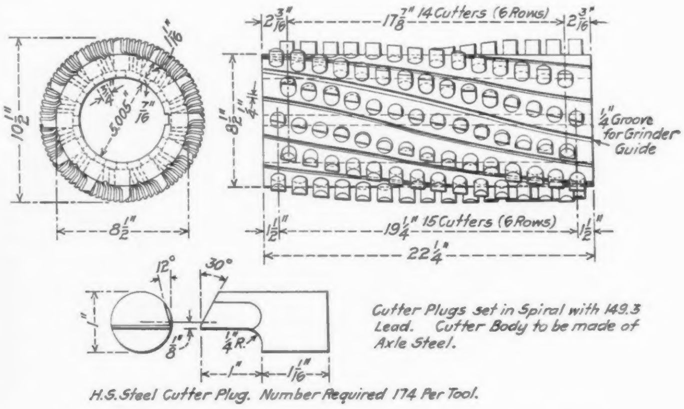



Fig. 8—Construction of Inserted Tooth Milling Cutter

2 in.; there is a bearing surface at each end $1\frac{3}{8}$ in. long and a keyway at one end for a $\frac{3}{8}$-in. key.

Cutters of this design after they have been ground in resharpening to a point where the teeth require reforming, are recut and this process is repeated until the outside diameter has been reduced to $3\frac{3}{8}$ in., which means that only a 5/16-in. wall remains between the bore and the bottom of the tooth fillet. But even with this marked reduction in diameter, the teeth are amply coarse and the space between them sufficient to give satisfactory results.

Fig. 5 represents the process of recutting a mill of this pattern. To all appearances the work is quite like a fresh cutter except for the narrowing down of the land at the top of the tooth (which will of course be ground after the cutter is again hardened and tempered) and the generally smaller diameter of the mill at both top and bottom of the tooth. This

view illustrates an interesting example of tool room work in that it shows the universal milling machine set up with its spiral dividing head for rotating the cutter through the desired angle of helix and for indexing for one tooth after another as fast as successive fluting cuts are made.

Another operation on a similar cutter is shown in Fig. 6 to show the simple process of putting in the keyway for a new cutter. Here the cutter is shown set up on the vertical key seater where it is handled in the same manner as any good job of keyseating would be put through the machine.

### INSERTED TOOTH CUTTERS

An example of one of the latest milling cutters developed at this shop is the inserted tooth mill shown in Figs. 7 and 8. This cutter is used with another of the same dimensions on a heavy horizontal milling machine for slabbing locomotive side rods and other large members of similar requirements.

The cutter is 22¼-in. long over all; it measures 10½ in. in diameter and has 12 rows of inserted teeth or cutter plugs staggered in alternate rows and numbering 174 plugs in all. These plugs are of Mushet steel inserted in one inch holes bored radially in an axle steel center. Here they are set in to a depth of 1 1/16 in. and the alternate rows are staggered to cover with one row the gaps left between the teeth of the next row. The spiral line along which the teeth are located has a lead of 149.3 in., the equivalent of an angle with the axis of approximately 12 deg.

The cutting faces of the plug teeth are milled ⅛-in. ahead of the center as indicated in the detail, and their ends are relieved or backed off at an angle of 30 deg.

This mill is shown in operation in the lower part of Fig. 9, one of these views representing one cutter in the process of slabbing off the broad face of a side rod forging while in the other a pair of cutters are set up for milling the edges of rods. With the machine set up thus provision is made for facing four rods at once with the two cutters, but at the time the photograph was taken this lot of rods had been completed except for the two shown in place, hence the cutter on the left end of the spindle is not represented in operation. The depth of cut along the edges of the forgings will average from ⅜ to ½ in. and at the big end it runs up to about 2½ in. for a short distance. The cutter is driven at 22 revolutions per minute which gives a surface speed of 60 feet per minute. The rate of feed is 2 in. per minute. The facing of the side of the rod is accomplished with the milling cutter running at 22 revolutions per minute and with a feed of 1½ in. per minute. The depth of metal removed in the one cut is ⅜ in. for each side of the forging. The cutter has a 5-in. bore, giving some conception of the dimensions of the carrying and supporting members.

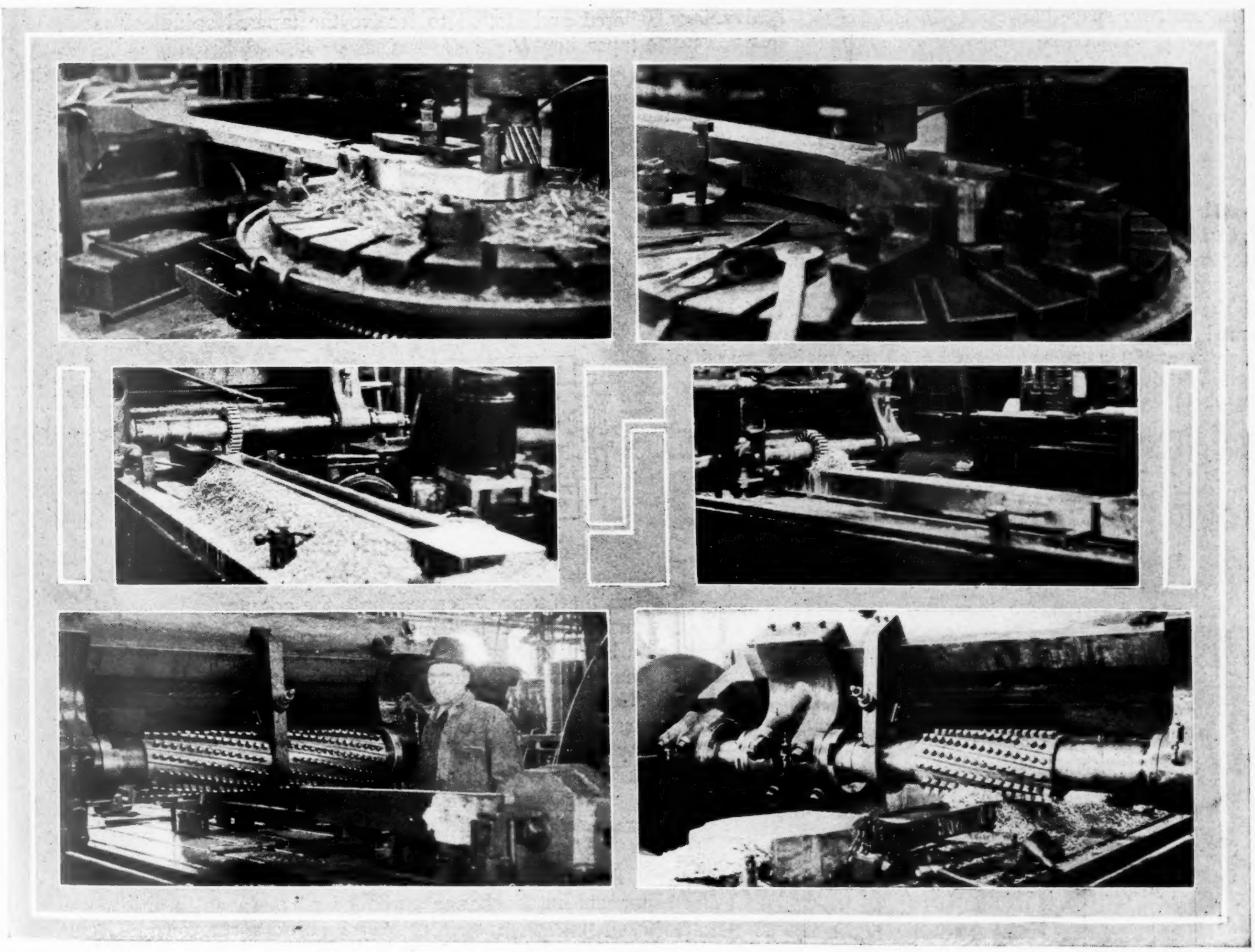


Fig. 9—Examples of Locomotive Work Done with Modern Milling Cutters

### SOME MILLING OPERATIONS

Fig. 9 shows several characteristic jobs done with these milling cutters. The picture at the top and left shows some work being finished by the milling cutter illustrated in Fig. 4. The job underway is the milling of the edge of a front side rod at the rounded rear end where the forging is about 4 in.

deep at the broadest point and the amount of metal to be removed ranges from say 3/8 to 5/8 in. on a side. The cutter is rotated at 30 r. p. m. giving it a surface speed of 45 ft. per minute and the work is fed at about 2 in. per minute while the circular end is being milled, the rate being higher for the straight portions along the sides. The surface is finished in the one cut.

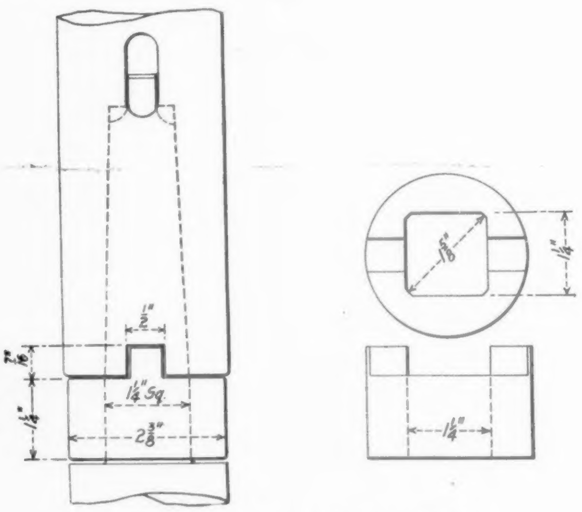
Another job of connecting rod milling is shown at the right, where a 2-in. shank mill is seen in the vertical spindle miller in operation in the opening for the main rod wedge. This mill is necessarily of slender proportions owing to the restricted space in which it is operated and it is consequently fed at a slower rate than that maintained for the larger cutter in the preceding illustration. This slender mill, however, has the same coarse tooth and is in fact similar to the two shank mills seen to the right in the group in Fig. 3. The depth of cut through the rod is 4 in. and the liberal chip space between teeth is of especial advantage. Aside from the fact that the form of tooth made this possible it gives a stronger tool and permits a much cleaner cutting action when being operated.

Two views of channelling operations in locomotive main rods are also shown in Fig 9. Here a 7-in. side cutter is used on the horizontal miller, the cutting having a face of 2 in. and two cuts being taken from end to end to bring the channel to desired width. Each cut is made full depth. The length of the cut is about 65-in. and the depth to which the cutter is sunk in milling the channel is 1 3/4 in. With this deep cut a feed of nearly 2 in. per minute is maintained and the time for each of the two parallel cuts to form the channel is a little less than 40 minutes. The cutter arbor is driven at 50 r. p. m., giving a cutter surface speed of approximately 85 ft. per minute.

With all of the operations illustrated in this article a liberal supply of lubricants is provided for the cutter and the work.

## NOVEL METHOD OF DRIVING DRILLS

In the drawing below is shown a method of driving large drills, reamers, etc., to relieve the stresses on the tang of the tool, which is used in the West Burlington (Iowa) shops of the Chicago, Burlington & Quincy. The spindle of the drill press has a keyway at the lower end in line with the



Collar Used for Driving Large Drills

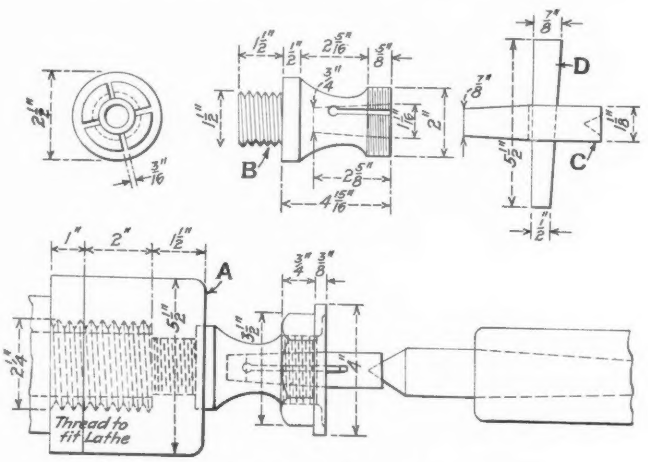
socket for the tang. The tool to be used in the drill press is squared just below the shank with two sides parallel with the tang. A collar is made to fit over this square, with lugs on the upper side to match the keyway in the spindle. Thus the force is transmitted from the spindle to the drill through the collar. The dimensions shown in the accompanying sketch are those used for collars to fit tools having a No. 4 Morse taper shank.

## JIG FOR MACHINING NUTS

BY J. LEE
Shop Engineer, Canadian Pacific, Winnipeg, Man.

The jig illustrated is for use on lathes in facing and machining nuts and similar threaded work, such as wrist pin nuts, knuckle pin nuts, grease plugs, etc. It consists primarily of a fitting *B* which is made up in various sizes to suit the nuts which are to be made. This fitting is threaded on the left hand end to suit the adapter *A* which screws on the lathe spindle. The right hand end of *B* is bored and slotted to receive the tapered spindle *C* and the taper key *D*.

In operation the adapter *A* is screwed on the lathe spindle




Method for Facing Nuts.

and the fitting *B* screwed into the adapter. The nut is then turned on to *B* by hand. The spindle *C* is inserted and the tailstock center is used to force it into *B*. This opens the four slots in *B*, thereby tightening the nut firmly in place. After the nut has been faced down or machined to the thickness required, the tail center may be backed out and the taper key *D* is used to withdraw the spindle, a tapered slot in *C* being provided for this purpose. This jig will be found a material time saver where there are many nuts to be machined or thinned down.

A NEW TYPE OF GEAR-BOX CONSTRUCTION.—In a permanent mesh change speed gear-box invented in England, each pair of gears is provided with a spring operated clutch which tends to keep it in operation, but, by a system of levers, all clutches but the one selected are held out of contact at a time.—*The Engineer, London.*

THE WAGE INCREASE.—Take the first three numbers of your 1917 automobile license and add it to the size of your shoes, then subtract the number of buttons missing from your last summer's suit and divide by the size of your collar. Add to this the total amount of your unpaid taxes and laundry bills and divide by eighty per cent of your telephone number. Next add the combined weight of your family plus your serial number in the draft and divide by the total number of speeches that Mr. McAdoo has made on the increase for railroad employees. The result will be the amount of increase in rate of pay that you may expect.—*The M. K. & T. Employees Magazine.*

# SHOPMEN'S WAGES ARE INCREASED

### The Car Department Men Receive a Minimum Hourly Wage of 58 Cents; Locomotive Men 68 Cents

THE full text of Supplement No. 4 to General Order No. 27 provides for increases to shopmen of nearly all classes, but a further increase is expected for some of the higher skilled trades which have hitherto enjoyed a differential, such as pattern makers, passenger car repair men, oxy-acetylene, thermit and electric welding, car repair work, etc. These trades have requested a further hearing and their case will be taken up before the Board of Railroad Wages and Working Conditions.

The full text of Supplement No. 4 follows:

In the matter of wages, hours, and other conditions of employment of employees in the mechanical departments (specified herein) of the railroads under Federal control it is hereby ordered:

ARTICLE 1.—CLASSIFICATION OF EMPLOYEES.

SECTION 1.—*Machinists.*—Employees skilled in the laying out, fitting, adjusting, shaping, boring, slotting, milling, and grinding of metals used in building, assembling, maintaining, dismantling, and installing locomotives and engines (operated by steam or other power), pumps, cranes, hoists, elevators, pneumatic and hydraulic tools and machinery, scale building, shafting and other shop machinery; ratchet and other skilled drilling and reaming, tool and die making, tool grinding and machine grinding, axle, wheel and tire turning and boring; engine inspecting; air equipment, lubricator and injector work; removing, replacing, grinding, bolting and breaking of all joints on superheaters, oxy-acetylene, thermit and electric welding on work generally recognized as machinists' work; the operation of all machines used in such work, including drill presses and bolt threaders using a facing, boring or turning head or milling apparatus, and all other work generally recognized as machinists' work.

1-A.—*Machinist apprentices.*—Include regular and helper apprentices in connection with the above work.

1-B.—*Machinist helpers.*—Employees assigned to help machinists and apprentices. Operators of all drill presses and bolt threaders not equipped with a facing, boring or turning head or milling apparatus, bolt pointing and centering machines, wheel presses, bolt threaders, nut tappers and facers; cranesmen helpers, tool-room attendants, machinery oilers, box packers and oilers; the applying of couplings between engines and tenders, locomotive tender and draft rigging work, except when performed by carmen.

SECTION 2.—*Boilermakers.*—Employees skilled in laying out, cutting apart, building or repairing boilers, tanks and drums, inspecting, patching, riveting, chipping, caulking, flanging and flue work; building, repairing, removing and applying steel cabs and running boards; laying out and fitting up any sheet iron or sheet steel work made of 16 gage or heavier, including fronts and doors; grate and grate rigging, ash pans, front end netting and diaphragm work; engine tender steel underframe and steel tender truck frames, except where other mechanics perform this work; removing and applying all stay bolts, radials, flexible caps, sleeves, crown bolts, stay rods and braces in boilers, tanks and drums, applying and removing arch pipes; operating punches and shears for shaping and forming, pneumatic stay bolt breakers, air rams and hammers; bull, jam and yoke riveters; boilermakers' work in connection with the building and repairing of steam shovels, derricks, booms, housings, circles and coal buggies; eye beam, channel iron, angle iron and tee iron work; all drilling, cutting and tapping, and operating rolls in connection with boilermakers' work; oxy-acetylene, thermit and electric welding, on work generally recognized as boilermakers' work; and all other work generally recognized as boilermakers' work.

2-A.—*Boilermaker apprentices.*—Include regular and helper apprentices in connection with the above.

2-B.—*Boilermaker helpers.*—Employees assigned to help boilermakers and their apprentices. Operators of drill presses and bolt cutters in the boiler shop, punch and shear operators (cutting only bar stock and scrap).

SECTION 3.—*Blacksmiths.*—Employees skilled in welding, forging, shaping, and bending of metal; tool dressing and tempering; spring making, tempering, and repairing; potashing, case and bichloride hardening; flue welding under blacksmith foreman; operating furnaces, bulldozers, forging machines, drop-forging machines, bolt machines and Bradley hammers; hammersmiths, drop hammermen, trimmers, rolling mill operators; operating punches and shears doing shaping and forming in connection with blacksmiths' work; oxy-acetylene, thermit and electric welding on work generally recognized as blacksmiths' work, and all other work generally recognized as blacksmiths' work.

3-A.—*Blacksmith apprentices.*—Include regular and helper apprentices in connection with the above.

3-B.—*Blacksmith helpers.*—Employees assigned to helping blacksmiths and apprentices; heaters, hammer operators, machine helpers, drill press and bolt-cutter operators, punch and shear operators (cutting only bar stock and scrap), in connection with blacksmiths' work.

SECTION 4.—*Sheet-metal workers.*—Sheet-metal workers shall include tinners, coppersmiths and pipe fitters employed in shop yards and buildings and on passenger coaches and engines of all kinds, skilled in the building, erecting, assembling, installing, dismantling and maintaining parts made of sheet copper, brass, tin, zinc, white metal, lead and black planished and pickeled iron of less than 16 gage, including brazing, soldering, tinning, leading and babbitting; the bending, fitting, cutting, threading, brazing, connecting and disconnecting of air, water, gas, oil and steam pipes; the operation of babbitt fires and pipe-threading machines; oxy-acetylene, thermit and electric welding on work generally recognized as sheet metal-workers' work, and all other work generally recognized as sheet-metal workers' work.

4-A.—*Sheet metal worker apprentices.*—Include regular and helper apprentices in connection with the above.

4-B.—*Sheet metal worker helpers.*—Employees regularly assigned as helpers to assist sheet metal workers and apprentices.

SECTION 5.—*Electrical workers, first class.*—Employees skilled in repairing, rebuilding, installing, inspecting and maintaining the electric wiring of generators, switchboards, motors and controls, rheostats and control, static and rotary transformers, motor generators, electric headlights and headlight generators; electric welding machines, storage batteries and axle lighting equipment; pole lines and supports for service wires and cables, catenary and monorail conductors and feed wires, overhead and underground winding armatures, fields, magnet coils, rotors, stators, transformers and starting compensators; all outside and inside wiring in shops, yards, and on steam and electric locomotives, passenger train and motor cars, and include wiremen, armature winders, switchboard operators, generator attendants, motor attendants, substation attendants, electric crane operators for cranes of 40 tons capacity or over; cable splicers, linemen and groundmen, signalmen and signal maintainers, where handling wires and apparatus carrying 240 volts or over, or in dense traffic zones, and all other work properly recognized as first-class electrical workers' work.

5-A.—*Electrical workers, second class.*—Operators of electric cranes of less than 40 tons capacity; linemen and groundmen, signalmen and signal maintainers, where handling wires and apparatus carrying less than 240 volts, and in normal traffic zones, and all other work properly recognized as second-class electrical workers' work.

5-B.—*Electrical worker apprentices.*—Include regular and helper apprentices in connection with the above.

5-C.—*Electrical worker helpers.*—Employees regularly assigned as helpers to assist electrical workers and apprentices, including electric lamp trimmers who do no mechanical work.

SECTION 6.—*Carmen.*—Employees skilled in the building, maintaining, dismantling, painting, upholstering, and inspecting of all passenger and freight train cars, both wood and steel; planing mill, cabinet and bench carpenter work, pattern and flask making, and all other carpenter work in shop and yards; carmen's work in building and repairing motor cars, lever cars, hand cars, and station trucks; building, repairing, removing, and applying locomotive cabs, pilots, pilot beams, running boards, foot and headlight boards, tender frames and trucks; pipe and inspection work in connection with air-brake equipment on freight cars; applying patented metal roofing; repairing steam-heat hose for locomotives and cars; operating punches and shears doing shaping and forming, hand forges and heating torches, in connection with carmen's work; painting, varnishing, surfacing, lettering, decorating, cutting of stencils and removing paint; all other work generally recognized as painters' work under the supervision of the locomotive and car departments; joint car inspectors, car inspectors, safety appliance, and train-car repairers, wrecking derrick engineers, and wheel-record keepers; oxy-acetylene, thermit, and electric welding on work generally recognized as carmen's work, and all other work generally recognized as carmen's work.

6-A.—*Carmen apprentices.*—Include regular and helper apprentices in connection with the above.

6-B.—*Carmen helpers.*—Employees regularly assigned to help carmen and apprentices; car oilers and packers, material carriers, and rivet heaters; operators of bolt threaders, nut tappers, drill-presses, and punch and shear operators (cutting only bar stock and scrap).

SECTION 7.—*Molders.*—Include molders, cupola tenders, and core makers.

7-A.—*Molder apprentices.*—Include regular and helper apprentices in connection with the above.

7-B.—*Molder helpers.*—Employees regularly assigned to help molders, cupola tenders, core makers and their apprentices.

ARTICLE II—RATES AND METHOD OF APPLICATION.

SECTION 1. For the above classes of employees (except carmen, second-class electrical workers, and all apprentices and helpers), who have had four or more years' experience and who were on January 1, 1918, receiving less than 55 cents per hour, establish basic minimum rate of 55 cents per hour, and to this basic minimum rate and all other hourly rates of 55 cents per hour and above, in effect as of January 1, 1918, add 13 cents per hour, establishing a minimum rate of 68 cents per hour.

SECTION 1-A. For carmen and second-class electrical workers who have had four or more years' experience and who were on January 1, 1918, receiving less than 45 cents per hour, establish a basic minimum rate of 45 cents per hour, and to this minimum basic rate and all other hourly rates of 45 cents and above, in effect as of January 1, 1918, add 13 cents per hour, establishing a minimum rate of 58 cents per hour.

SECTION 1-B. Rates of compensation exceeding the minimum rates established herein to be preserved; the entering of employees in the service or the changing of their classification or work shall not operate to establish a less favorable rate or condition of employment than herein established.

SECTION 1-C. The Director General recognizes that the minimum rates established herein may be exceeded in the case of men of exceptional skill,

who are doing special high-grade work, which has heretofore enjoyed a differential. Such cases would include pattern makers, passenger car repair men, oxy-acetylene, thermit, and electric welding in car repair work, etc., and should be presented to the Board of Railroad Wages and Working Conditions for recommendation as provided in General Order No. 27.

SECTION 2. The above classes of employees (except carmen, second-class electrical workers, and all apprentices and helpers) who have had less than four years' experience in the work of their trade will be paid as follows:

(a) One year's experience or less, 50 cents per hour.

(b) Over one year and under two years' experience, 53 cents per hour.

(c) Over two years' and under three years' experience, 57 cents per hour.

(d) Over three years' and under four years' experience, 62 cents per hour.

SECTION 2-A. Carmen and second-class electrical workers who have had less than four years' experience in the work of their trade will be paid as follows:

(a) One year's experience or less, 48½ cents per hour.

(b) Over one year and under two years' experience, 50½ cents per hour.

(c) Over two years' and under three years' experience, 52½ cents per hour.

(d) Over three years' and under four years' experience, 54½ cents per hour.

SECTION 2-B. At the expiration of the four-year-period the employees mentioned in section 2 and section 2-A shall receive the respective minimum of their craft.

ARTICLE III.

SECTION 1. Regular apprentices between the ages of 16 and 21, engaging to serve a four-year apprenticeship, shall be paid as follows: Starting-out rate and for the first six months, 25 cents per hour, with an increase of 2½ cents per hour for each six months thereafter up to and including the first three years; 5 cents per hour increase for the first six months of the fourth year and 7½ cents per hour for the last six months of the fourth year.

SECTION 1-A. If retained in the service after the expiration of their apprenticeship, apprentices in the respective trades shall receive not less than the minimum rate established for their craft.

SECTION 2. Helpers in the basic trades herein specified will be paid 45 cents per hour.

SECTION 3. Helper apprentices will receive the minimum helper rate for the first six months, with an increase of 2 cents per hour for every six months thereafter until they have served three years.

SECTION 3-A. Fifty per cent of the apprentices may consist of helpers who have had not less than two consecutive years' experience in their respective trades in the shop on the division where advanced. In the machinist, sheet metal worker, electric and molder trades the age limit for advancement will be 25 years; in the boilermaker, blacksmith, and carmen trades 30 years.

SECTION 4. In the locomotive and car departments gang foremen or leaders and all men in minor supervisory capacity and paid on an hourly basis will receive 5 cents per hour above the rates provided for their respective crafts.

SECTION 5. The supervisory forces of the locomotive and car departments, paid on a monthly basis and exercising supervision over the skilled crafts, will be paid an increase of $40 per month in addition to the monthly rate as of January 1, 1918, with a minimum of $155 per month and a maximum of $250 per month.

ARTICLE IV.—GENERAL APPLICATION.

SECTION 1. Each railroad will in payments to employees on and after July 1, 1918, include these increases therein.

SECTION 1-A. The increases in wages and the rates established herein shall be effective as of January 1, 1918, and are to be paid according to the time served to all who were then in the railroad service, or who have come into such service since, and remained therein. A proper ratable amount shall also be paid to those who for any reason since January 1, 1918, have been dismissed from the service, but shall not be paid to those who have left it voluntarily. Men who have left the railroad service to enter the military service of the Army or Navy shall be entitled to the pro rata increase accruing on their wages up to the time they left, and the same rule shall apply to those who have been transferred from one branch of the railroad service, or from one road, to another.

SECTION 2. The hourly rates named herein are for an eight-hour day, and one and one-half time will be paid for all overtime, including Sundays and the following holidays: New Year's Day, Washington's Birthday, Decoration Day, Fourth of July, Labor Day, Thanksgiving, and Christmas.

SECTION 3. While the specific rates per hour named herein will be retroactive to January 1, 1918, the special overtime provisions established in section 2 of this article will be effective as of August 1, 1918, with the provision that in computing overtime to determine back pay to January 1, 1918, overtime will be paid at a pro rata rate for all overtime worked in excess of the hours constituting the recognized day or night shift, except where higher overtime rate basis exists, or has been applied, in which event the more favorable condition shall be the basis of computing back pay accruing from this order.

SECTION 4. Employees, except monthly salaried employees, coming within the scope of this order, sent out on the road for emergency service, shall receive continuous time from the time called until their return as follows: Overtime rates for all overtime hours whether working, waiting, or traveling, and straight time for the recognized straight time hours at home stations, whether working, waiting, or traveling, except that after the first 24 hours, if the work is completed or they are relieved for 5 hours or more, such time shall not be paid for, provided that in no case shall an employee be paid for less than 8 hours on week days and 8 hours at one and one-half time for Sundays and holidays for each calendar day. Where meals and lodging are not provided by the railroad an allowance will be made for each meal or lodging. Employees will receive allowance for expenses not later than the time when they are paid for the service rendered.

SECTION 5. Employees specified herein when sent from home point to temporarily fill vacancy or perform work at outside division points, will be paid straight time and overtime rates as per shop rules, including going and return trip, in addition to which they will be paid pro rata at the rate of $2 per day for meals and lodging.

SECTION 6. Carmen stationed at points requiring only one employee on day shift or night shift, or day and night shifts, shall be paid eight hours at not less than the hourly rate provided herein.

SECTION 7. Mechanics now regularly assigned to perform road work and paid on a monthly basis shall be paid for eight hours at not less than the hourly rate provided herein.

SECTION 8. Employees on a piecework basis shall receive not less than the minimum rate per hour awarded to the hourly workers, including time and one-half for overtime, as hereinbefore provided; otherwise piecework rates provided in General Order No. 27 shall apply.

SECTION 9. The application of this order shall not, in any case, operate to establish a less favorable wage rate than in effect January 1, 1918.

ARTICLE V.—PAYMENTS FOR BACK TIME.

SECTION 1. As promptly as possible the amount due in back pay from January 1, 1918, in accordance with the provisions of this order, will be computed and payment made to the employees, separately from the regular monthly payments, so that employees will know the exact amount of these back payments.

SECTION 2. Recognizing the clerical work necessary to make these computations for back pay, and the probable delay before the entire period can be covered, each month, beginning with January, shall be computed as soon as practicable, and, as soon as completed, payments will be made.

ARTICLE VI.—INTERPRETATION OF THIS ORDER.

SECTION 1. Railway Board of Adjustment No. 2 is authorized by Article IX of General Order No. 27 to perform the following duty:

"Wages and hours, when fixed by the Director General, shall be incorporated into existing agreements on the several railroads, and should differences arise between the managements and the employees of any of the railroads as to such incorporation, such questions of difference shall be decided by the Railway Board of Adjustment No. 2 when properly presented, subject always to review by the Director General."

SECTION 2. In addition to the foregoing other questions arising as to the intent or application of this order in respect to the classes of employees within the scope of the Railway Board of Adjustment No. 2 shall be submitted to such board, which board shall investigate and report its recommendations to the Director General.

SECTION 3. All rates applied under this order shall be filed by the Regional Directors with the Board of Railroad Wages and Working Conditions.

SECTION 4. The rates, increases, and other conditions of employment herein established for the classes of employees herein specified shall supersede the rates, increases and other conditions established by General Order 27, except as provided in section 8, Article IV.

STATEMENT BY MR. MC ADOO

The concluding section of the supplement is a statement by Mr. McAdoo reading as follows:

In reaching the conclusions upon which this order is based, I have been keenly conscious not alone of the interests of the large number of railway employees who are greatly benefited thereby, but also of my solemn duty to the American people to see to it that the trust they have committed to me is discharged faithfully, with justice to them as well as to the railroad employees concerned. No right decision can be made which considers only the demands and interests of any class of men apart from the paramount interest of the public and the supreme necessity of winning this war.

Now that the decision has been made, the American people, whose servants we are, expect every railroad employee to devote himself with new energy to his work, and by faithful and efficient service, to justify the large increases of pay and the improvement in working conditions hereby granted. The American people have a right to expect this and they will be content with nothing less.

It is of the utmost importance that motive power and cars shall be kept in repair and that the output of railroad shops throughout the country shall be greatly increased in the future. Unless this is done, the railroads can not efficiently perform the increased duties imposed upon them by the war, and the fighting power of our armies in France and of our navies on the high seas will be seriously impaired.

I am proud of the loyal service the great body of railroad men throughout the country have rendered to their Government since the railroads have come under Federal control. It is a genuine pleasure to make this acknowledgment, but I

should not fail to say at the same time that there are instances where agitations and disturbances in some of the locomotive and car shops have been extremely hurtful to the country. The loyal and patriotic employees, who constitute the great majority of the army of railroad workers, have not yielded, be it said to their credit and honor, to these disturbances. But the few who have, have done their country a grievous injury by impairing the efficiency and reducing the output of the shops where these disturbances have occurred.

The loyal and patriotic employees can render a new and powerful service to their country by using their influence to expose any who may become slackers in their work, by co-operating with their officers in the enforcement of discipline, and by increasing, to the utmost limit of their capacity, the output of locomotives and cars which are so essential to the efficient operation of the railroads of the country and to the success of our armies in the field. I know I can count on the patriotism and devotion to duty of every true American engaged in the railway service of the United States.

#### SHOP MEN SATISFIED WITH RECENT INCREASE

Reports received by officers of the Railroad Administration are to the effect that officers and men alike are well satisfied with the increases in pay to shopmen announced in Supplement No. 4 to General Order No. 27. Mechanical officers in different parts of the country who have been heard from say that many skilled men who had left them to go into other work have begun to return to their railroad jobs and some say that the advance wages are proving sufficient to attract also skilled mechanics new to railway work. In fact, on most railroads there are more mechanical department employees on the payrolls now, in both the car and the locomotive departments, than there were at this time last year.

*Men Jointly Employed.*—In circular letter No. 355 the southern director draws attention to the fact that in the case of men jointly employed by several railroads, some of which are under government control and others which are not under government control, the increases in pay under General Order No. 27 will apply, even though in some instances the actual pay check may be issued by the railroad not under government control.

*Compensation for Sub-Foreman.*—The eastern regional director has issued the following: The following letter from C. R. Gray, director, Division of Operation, dated Washington, August 15, 1918, is quoted for your information and guidance:

Supplement No. 4 to General Order No. 27 provides that sub-foremen in the mechanical department, such as gang leaders and leading workmen, shall be paid 5 cents per hour more than the craft which they are supervising.

Our attention has been called to the fact that this creates inequalities between certain railroads on account of some of these sub-foremen having been heretofore paid on a monthly basis.

In order to preserve uniformity you may authorize Federal and general managers to place all of these men on an hourly basis.

## THE COST OF OXY-ACETYLENE WELDING

In discussing the paper on electric arc and oxy-acetylene welding read by A. F. Zoebrest before the Niagara Frontier Car Men's Association, Neil Marple of the Michigan Central quoted the following figures as the cost per cubic inch of welding by the oxy-acetylene process.

| Size of weld in cu. in. | Amount of gas consumed | Amount of oxygen consumed | Amount of welding metals used | Material | Labor | Total |
|---|---|---|---|---|---|---|
| 1.3125 | 15 lb. | 200 lb. | 1½ lb. | $0.88 | $0.49 | $1.37 |
| 3.75 | 50 lb. | 350 lb. | 2 lb. | 2.29 | .84 | 3.13 |
| 2.812 | 30 lb. | 260 lb. | 2¼ lb. | 1.49 | .70 | 2.19 |
| 2.32 | 32 lb. | 265 lb. | 2¾ lb. | 1.61 | .91 | 2.52 |
| 1.265 | 20 lb | 200 lb. | 1½ lb. | 1.03 | .42 | 1.45 |

Acetylene 3 cents per lb., average 250 lb. per tank.
Oxygen 14 cents per cwt., average 1,800 lb. per tank.
Welding metal 10 cents per lb. Labor 42 cents per hour.

The average cost per cubic inch as shown by the above quotations is, approximately, $1.00 per cubic inch.

## A METHOD OF REGULATING SHOP OUTPUT

BY E. T. SPIDY

Did you ever hear this said in a railroad shop: "Well, one thing is sure, if we were in a manufacturing business we couldn't afford to do it this way." The writer, who has put in fourteen years in railroad shops and who now is actively engaged in an industrial shop, believes that this thought is only too common, and in consequence many manufacturing shop methods are not considered as practical to the railroadmen and in consequence get little or no consideration.

Railroad shops are simply a series of manufacturing shops where the quantity handled at one time is in some departments small and in others it is large. This point does not constitute a difference with manufacturers as many think. The difference lies in the fact that a railroad shop often does not know what it has to do until the job is right in the shop, whereas the manufacturer usually knows all the work that has to be done when he gets an order.

If, however, the railroad reader will think of the following as being applied to his shop and consider the man that he delivers his work to as his customer, he will realize that there is a mighty close relationship between his own methods and whatever he considers manufacturing methods, and though no two applications of a principle are alike, it may throw a light on future possibilities.

#### CONTROL OF SHOP OPERATIONS

The delivery of orders in hand is at the present time the most important job we have—most of us have, I should perhaps have said. If we have a small shop then we can perhaps recite off all our orders with precision, but if we have a large shop, and the larger we have the more difficult and the less accurate our estimates become, it is hard to know exactly where we stand with regard to each and every order.

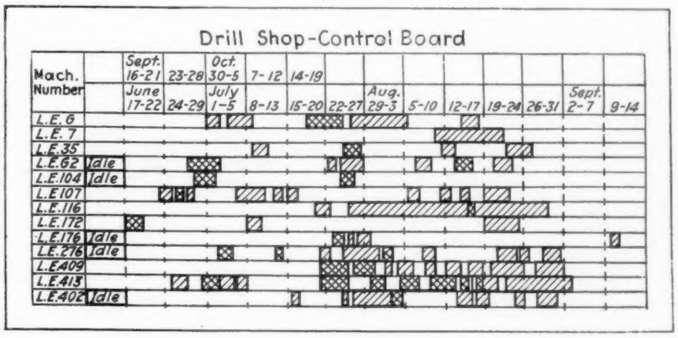



Fig. 1—An Example of the Arrangement of the Control Board

The larger the shop the further away the actual order gets from head of the shop because more bosses and sub-bosses get between the man for whom the job is being done and the man on the shop floor who is actually doing the work.

Now, while we all believe that our own way is quite right and that the other fellow's way may suit him, too, we are quite willing to admit that now and then we do pick up an idea from seeing just how the other fellow does his work, and it is with this thought in mind that the following description is written. There is no claim for any originality in the scheme, which is a natural evolution from the small shop to the big shop way of doing things.

To get a correct angle on the situation, assign yourself to the position of a supervisor who wants to get a line on what a shop is doing. You size up the number of men in the shop, you look over the machines and note what is apparently not running. You look over the list of orders which most likely numbers hundreds and you inquire into the material

situation, in fact, you get into all kinds of detail regarding that particular shop. Without a doubt you will find many ways in which you can help the man in charge, if such is your desire, to increase his output. But do you get a real idea as to the general condition of the shop and its orders as a whole? Do you know whether the delivery of orders is on the whole one week or many months late? If they are late, what is the cause? Is it the machine capacity of the shop that is delaying deliveries? Is it the lack of man power? Is it on account of too optimistic promises of deliveries? Or what is the matter?

Most of us are well aware that something is the matter, and if we are to manage the situations that are today forced on us, any means that shows us where we are off the track

SCHEDULE ROUTING SHEET

H. Drill No. 4 Shop. Lot No. 7752 Pieces: 25

Description: DD17 Clutches

| | Operation | Mach. No. | Time lot (hrs.) | Hrs. | Date to start | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Bore, turn and cut-off | 654 | 30 | ... | 7/12 | ... | ... | ... | ... |
| 2. | Mill clutch | 198 | 40 | ... | 7/15 | ... | ... | ... | ... |
| 3. | Finish turning | 310 | 13 | ... | 7/20 | ... | ... | ... | ... |
| 4. | Vise | $V_2$ | 10 | ... | 7/23 | ... | ... | ... | ... |
| 5. | Carbonize | Car. | 4 | ... | 7/25 | ... | ... | ... | ... |
| 6. | Oil treating | O. T. | 10 | ... | 7/26 | ... | ... | ... | ... |
| 7. | Grind outside | 314 | 12 | ... | 7/29 | ... | ... | ... | ... |
| | Finish promise | ... | ... | ... | 8/5 | ... | ... | ... | ... |

Note—The last four columns of the table are for revised dates.

Remarks:

Operation 1 started July 13.
Operation 2 started July 17—2 scrapped.
Operation 3 started July 21—23 pieces.
Operation 5 waiting for compound. Started July 28.

Fig. 2—Sample of a Schedule Routing Sheet

are very acceptable. The writer has always appreciated graphical methods because they give direct readings without any figuring and has found the following methods effective.

In the first place a survey of a plant naturally divides all departments into manufacturing departments and supply departments. The manufacturing shops are those with orders for finished work and all other departments are in the nature of supply depots or sources of supply for material. Now in many shops every boss goes to the source of supply himself and places his order, traces it up until he gets it. The boss with the most persuasive power usually gets the most, sometimes delaying more important orders in other departments. This continual "When can I get this?" and "When can I promise that for?" ends in the average case in most every job being promised for "two weeks" with the effect known only too well.

The writer has been led to the conclusion that the clearing house system as applied by the banks is the right idea for interdepartmental operations. Instead of 100 (more or less) bosses being in communication with each other, they all communicate with one central department which issues and receives all orders to all departments. In this central department are a series of boards which we call "Machine Loading Boards" or "Control Boards," one board being used for each shop. These boards contain a series of slots from top to bottom extending the complete width of the board. The left hand side of each slot is labelled with the machine number and symbol or man's name and all operations done at that machine are put into that slot. Along the top of the board is marked a series of dates covering a period of about 14 weeks. The scale used is three inches to one week, which to facilitate reading is marked all the way down the boards by white dots in weekly spacings. For each operation a ticket is made out on profile paper with 20 lines to the inch, each line representing one hour. The length of each ticket made out is equal to the time allowed for the job, that is to say, the length of the ticket varies with the time allowed. For instance, if the operation is to mill 25 pieces and one hour is allowed for each piece the ticket will have 25 lines for the 25 hours or be 1¼ in. long. The tickets are placed in the boards on the line representing the machine on which the job is to be done and under the date it must be started in order to make a certain finish date. It is obvious that if the machine chosen for the job is so loaded with other operations that this particular job has to be put back several weeks, it will be necessary to find some other machine, method, or shop to do it in if the work cannot be delayed that long. Herein is one of the big advantages of the board. We can see at a glance whether the boring mills, for instance, in Shops Nos. 4 or 5 are loaded as much as those in Shop No. 1, and do thus transfer the job if necessary. The manner in which the boards are marked is shown in Fig. 1.

Our method of handling these boards is to make out a list of the operations and the times allowed from standard schedule of operations for each job on receipt of every order on what we call a "Schedule Route Sheet" (see Fig. 2), using premium times when available and estimating them temporarily for the board purpose when times are not in the standard operation schedule. Tickets are then made for each operation. All new tickets are placed in boards at least once a day and all operations completed are also marked up or removed. All daily time cards and premium cards are

Production Department

DAILY ORDER OF WORK SHEET

Date, August 6, 1918.

Mr. Lemire. Turrets. Shop, Drill Shop No. 4.

The Following Operations and Material Are Late or Due:

| Lot No. | Date | Description | Operation | Machine No. |
|---|---|---|---|---|
| 13477 | 27.7 | Pins | Make | LA 285 |
| 565 | 27.7 | Belt wheels stud | Make | LA 285 |
| 20286 | 24.7 | JC10 screw | Thd. for handle | JL 1051 |
| 19873 | 24.7 | 7¼x10 rings | Bo. tn. & co | PJ 169 |
| 19919 | 24.7 | Valve blk. pins | Turn thread | JL 1051 |
| 19722 | 19.7 | 43¼ feed nut | Tn. bo. rm. thd. co. | JL 266 |
| 19925 | 19.7 | Gr. shaft | Bo. fc. & turn | JL 405 Due July 27 |
| 30513 | 2.7 | Imp. unloader plug | Make | PJ 1049 xx |
| 19737 | 4.7 | Col. feet | Turn & face | LA 285 |
| 1T637 | 6.7 | Facing bar stop | Tn. thr. & bore | JL 859 |
| 1T637 | 16.7 | Bevel mill rocker | Fin. bo. & rgh. tn. | JL 859 |
| 19816 | 22.7 | 7x12 piston ring | Bore & turn | PJ 168 |
| 19337 | 31.7 | 43½ feed screw | Thread handle | JL 266 |
| 1163 | 31.7 | 200—¾ mche. swivels | Thr. pipe end | PJ 1049 |
| 565 | 6.8 | Holding device screw | Make | JL 143 Late xx |
| 19338 | 6.8 | 43¼ feed screws | Thread handles | JL 268 |
| 30560 | 6.8 | Crank pin cap screw | Make | JL 268 |
| 30554 | 6.8 | 1⅛x6 in. cap screw | Make | JL 1043 |
| 13467 | 6.8 | 1⅛ in. cap screw | Make | JL 1043 |
| 565 | 6.8 | Inlet valve screw | Make | PJ 1049 |
| 566 | 6.8 | Outlet valve screw | Make | PJ 1049 |
| 20335 | 6.8 | ⅜ in. oil plugs | Make | LA 152 |

Fig. 3—The Daily Order of Work Sheet

checked by the department each day for operations finished and started so that the boards are kept up to date all the time. An individual permanent record of each order is also kept on the schedule route sheets. Each day a "Daily Order of Work Sheet" (see Fig. 3), showing all operations due to be started and finished is issued to each assistant foreman and a complete set of sheets for each department is given to the general foreman. This sheet is made up from the shop control board and towards the end of each day a production department man checks them over with each foreman and records the delays, finished jobs, those in progress, etc., and makes a record of any other happenings influencing the work. On his return to the office each board is corrected

to correspond with the day's progress. On the tickets for work started or in progress is placed a short mark in red pencil. When the work is completely finished the ticket for the operation is marked red all over (shown by double cross-hatching in Fig. 1) and the next operation is looked up in the schedule and that ticket marked with a yellow pencil, which indicates that it must be on the next order of work sheet, and so on. The single crosshatched spaces represent work assigned to a machine but which has not been finished.

The boards will thus show at any particular period "How much work is ahead of each machine" and "How much late," and "What is late." Each day machines not working are tagged on the board with "IDLE" tickets, the reason for which is known or can be quickly ascertained.

The production department promises the delivery of all orders and thus relieves the foreman of making dates, which comparatively speaking, he has no adequate method of knowing whether he can keep. The production department is careful to make clear to every foreman that his status is in no way lowered because certain information is given him in a different way, and he is asked to regard the department as an active assistant rather than otherwise. As a matter of fact this happens as a matter of course.

One of the attractive features of this graphical method as compared with systems where the schedule of promised dates is in a book or on charts is that it is extremely flexible. We all know that a considerable number of dates have to be periodically changed. This is brought about because all orders on the shop by this method have a finish date. This is good shop practice because while we always give a customer's orders preference over stock orders the change does not let us forget it by any means. Every month each board is completely checked and the dates at the top of the board changed, one block is removed and a new block of dates inserted. It is seen in Fig. 1 that the new series of dates are appearing over the old dates on the left side, the next move the old dates will be removed entirely.

The "Foundry Control Board" is run on somewhat the same lines, but instead of dates we use a location letter on the bottom and a number on the side, to link the sheets with the board. In the foundry we know we can get so many boxes per day of one class of work and so many of another and so we arrange our "Order of Work" sheet so that the most important work is at the top. The scale used here is number of pieces instead of time allowed. The foundry boss works from the top downward in each section of the sheet under the heading "Main Floor," "Rollover," etc., which automatically makes a preference list. The order of the list is made from the dates material must be delivered to the various departments as seen from when first operation must start in each department.

We keep an accurate record of the percentage of dates that are maintained in each department according to the promises made and have thus a measure of co-operation received from each department. Record of the efficiency of every operation as compared with the base time allowed is also kept and all foremen are rewarded by a bonus dependent on the results of their own gang.

As a final word, it is seen that this is a means of keeping all work ahead clearly in view. It gives data, which, reported as soon as seen, shows conditions coming before they happen and not after when it does little good. It provides the necessary information to *lead* each department along, which gets co-operation instead of the drive and the criticize method.

A summary of a department which means something, is one that tells you that you have, for instance, 20,500 machine hours' work ahead represented in orders, and that since you have 60 machines in the department open for business 50 hours a week, you have 3,000 machine hours a week available, less a percentage that is idle on account of various known reasons—say 25 per cent—which gives 2,250 machine hours actually available. This shows that you have at present standing a little over nine weeks' solid work ahead, or, in other words, some of the present orders are nine weeks away from delivery.

These are real facts, obtainable quickly from these methods. If we prefer to go any way around it to show it differently the only persons really fooled are ourselves.

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## MEETING OF THE IRON AND STEEL ASSOCIATION

A meeting of the American Foundrymen's Association, the Iron and Steel section of the American Institute of Mining Engineers, the Institute of Metals Division of the American Institute of Mining Engineers and the American Malleable Castings Association will be held in Milwaukee, Wis., during the week of October 7, during which time an elaborate exhibition of metal working equipment will be made in the Milwaukee auditorium.

The keynote of many of the addresses and papers that will be presented at this meeting will be toward the acceleration of production for the prosecution and winning of the war. One of the notable features will be the large number of interesting moving pictures that will be shown. These will include the use and manufacture of hand grenades, the civil re-establishment of wounded and crippled Canadian soldiers, the manufacture and launching of ships at the Hog Island yard, Philadelphia, the building of concrete ships, the manufacture of steel by the triplex process, and the cause and prevention of industrial accidents.

Among the papers to be presented at the Foundrymen's meeting, the following will be of interest:

"Training Your Own Help Instead of Competing with Other Manufacturers," by Ernest Van Billiard and T. Hough, Jr., General Railway Signal Company, Rochester, N. Y.

Moving picture film on the "Manufacture and Use of Hand Grenades," by Major Frank B. Gilbreth, Providence, R. I.

"Annealing Malleable Iron," by H. E. Diller, General Electric Company, Erie, Pa.

"Use of Malleable Castings," by H. A. Schwartz, National Malleable Castings Co., Indianapolis.

"White Rim or Picture Frame Fractures," by J. B. Deisher, T. H. Symington Company, Rochester, N. Y.

In the program of the Institute of Metals Division of the American Institute of Mining Engineers are:

"Notes on Babbitt and Babbitted Bearings," by Jesse L. Jones.

Symposium on "The Conservation of Tin." This topic will be discussed by the following:

G. W. Thompson, National Lead Company.
G. H. Clamer, Ajax Metal Company, Philadelphia.
C. M. Waring, Pennsylvania Railroad Company.
M. L. Lissberger, Mark Lissberger & Son, Inc., Long Island City, N. Y.
D. M. Buck, American Sheet & Tin Plate Company, Pittsburgh.
W. M. Corse, Buffalo.
G. K. Burgess and Mr. Woodward, United States Bureau of Standards, Washington, D. C.
M. L. Dizer, War Industries Board, Washington, D. C.
A representative of the Niles, Bement, Pond Company, New York.
A representative of the Bureau of Steam Engineering, United States Navy Department, Washington, D. C.

"Accident Prevention Is Good Business," by Hon. Fred M. Wilcox, vice-president, Wisconsin Industrial Commission.

"What the Buckeye Steel Castings Company Has Accomplished in Accident Prevention," by Fred G. Bennett, safety director, Buckeye Steel Castings Company, Columbus, Ohio.

"The Importance of Organization in Accident Prevention," by C. W. Price, field secretary, National Safety Council, Chicago.

"What Shall Be Done with the Crippled Soldier," by W. A. Janssen, vice-president, Canadian Steel Foundries, Montreal, Canada.

Among the many papers to be presented at the Iron and Steel Section of the American Institute of Mining Engineers, will be the following:

"The Manufacture of Ferro-Alloys in the Electric Furnace," by R. M. Keeney.

"Notes on Some Iron Ore Resources of the World."

"The Use of Coal in Pulverized Form," by H. R. Collins.

"Carbocoal," by C. T. Malcolmson.

"Price Fixing of Bituminous Coal by the United States Fuel Administration," by R. V. Norris and others.

The exhibit at this joint meeting will be particularly inter-

esting. Already 165 manufacturers have reserved space at the auditorium. Among these the following will show products of particular interest to railway men:

Abrasive Company, Philadelphia.
Allis-Chalmers Manufacturing Company, Milwaukee.
American Kron Scale Company, New York.
E. C. Atkins & Co., Indianapolis.
Asbury Graphite Mills, Asbury, N. J.
Ayer Lord & Tie Company, Chicago.
Barrett Company, Chicago.
Beaudry & Co., Boston.
Bristol Machine Tool Company, Bristol, Conn.
Brown Specialty Machinery Company, Chicago.
Bullard Machine Tool Company, Bridgeport, Conn.
Carborundum Company, Niagara Falls, N. Y.
Central Electric Company, Chicago.
Chard Lathe Company, New Castle, Ind.
Cincinnati Pulley Machinery Company, Cincinnati.
Cleveland Pneumatic Tool Company, Cleveland.
Chipper Belt Lacer Company, Grand Rapids, Mich.
Dale-Brewster Machinery Company, Chicago.
Davis-Bournonville Company, Chicago.
Detroit Drill Company, Detroit.
Detroit Steel Products Company, Detroit.
Joseph Dixon Crucible Company, Chicago.
General Electric Company, Schenectady, N. Y.
General Steel Company, Milwaukee.
Greaves-Klusman Tool Company, Cincinnati.
Hauck Manufacturing Company, Brooklyn, N. Y.
Hayward Company, New York.
Henry & Wright Manufacturing Company, Hartford, Conn.
Herman Pneumatic Machine Company, Pittsburgh.
Hyatt Roller Bearing Company, New York.
Imperial Brass Manufacturing Company, Chicago.
Industrial Electric Furnace Company, Chicago.
Jennison-Wright Company, Toledo, Ohio.
Kearney & Trecker Company, Milwaukee.
Kempsmith Manufacturing Company, Milwaukee.
Julius King Optical Company, Chicago.
Lees Bradner Company, Cleveland.
David Lupton's Sons Company, Philadelphia.
Marshall & Huschart Machinery Company, Chicago.
McCrosky Reamer Company, Meadville, Pa.
Mueller Machine Tool Company, Cincinnati.
Macleod Company, Cincinnati.
Magnetic Manufacturing Company, Milwaukee.
Mahr Manufacturing Company, Minneapolis.
Metal & Thermit Corporation, New York.
Modern Tool Company, Erie, Pa.
Monarch Engineering and Manufacturing Company, Baltimore.
Naper Saw Works, Springfield, Mass.
Norma Company of America, New York.
Norton Company, Worcester, Mass.
Oakley Machine Tool Company, Cincinnati.
Oesterlein Machine Company, Cincinnati.
Ohio Machine Tool Company, Kenton, Ohio.
Oliver Machinery Company, Grand Rapids, Mich.
Oxweld Acetylene Company, Chicago.
Pangborn Corporation, Hagerstown, Md.
Pawling & Harnischfeger Company, Milwaukee.
Peerless Machine Company, Racine, Wis.
Phoenix Manufacturing Company, Eau Claire, Wis.
Quigley Furnace Specialties Company, New York.
Racine Tool & Machine Company, Racine, Wis.
*Railway Mechanical Engineer*, New York.
Rivett Lathe and Grinder Company, Boston.
Shepard Electric Crane and Hoist Company, Montour Falls, N. Y.
Simonds Manufacturing Company, Fitchburg, Mass.
Southworth Machine Tool Company, Portland, Me.
Standard Optical Company, Geneva, N. Y.
Strong, Kennard & Nutt Company, Cleveland.
Sullivan Machinery Company, Chicago.
Swan & Finch Company, Chicago.
Thomas Elevator Company, Chicago.
Torchweld Equipment Company, Chicago.
United States Graphite Company, Saginaw, Mich.
Warner & Swasey Company, Cleveland.
Western Electric Company, New York.
Whiting Foundry Equipment Company, Harvey, Ill.

## EVERY LITTLE BIT HELPS—DO A LITTLE BIT MORE

You can always do a little bit more. Just at the time you think you have exhausted every ounce of effort, you find that you are capable of still further accomplishment—and success instead of failure gladdens you!

You can lend more than you ever thought you could lend in this big War Savings Stamp campaign.

Did you ever fill a barrel of potatoes to the top until you could not get in another potato? Don't you know that you could still get in a bushel or so of beans, and a quart or two of peas, and if you wanted to do it, you could find room for a couple of pounds of meal or bran and even after that, pour in a couple of gallons of water?

It makes no difference how much you have contributed in Liberty Bonds, if you have not done ALL that you could do you have not done your share.

What if every one considered himself the self-constituted judge of how much he should do and when he should stop? Who would go on and win the war?

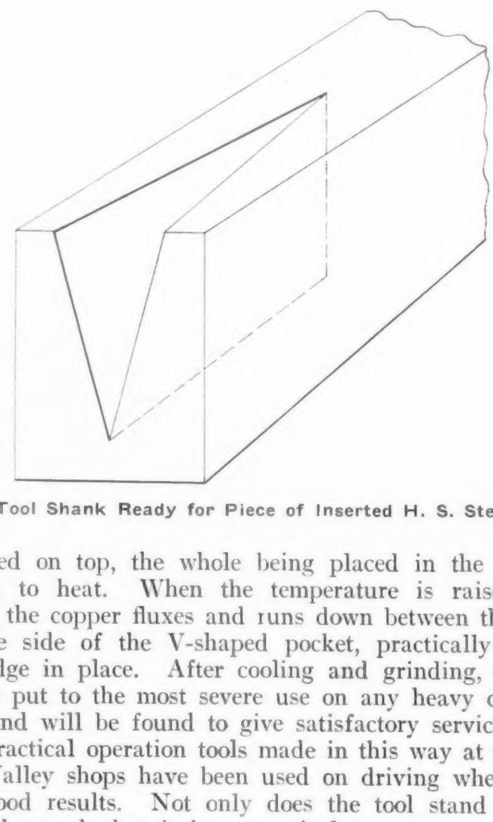
No, you can always do a little bit more and you'd better do it for yourself and for your country than for the Kaiser.

## TIPPING CARBON STEEL TOOLS

BY W. H. HALSEY
General Foreman, Chicago & North Western

A number of different ways of tipping carbon steel with high speed steel have been developed since the advance in price of high speed steel. Some tips are welded on by the acetylene process and others by the electric process, but the method shown in the illustration has proved to be very satisfactory at the Chicago & North Western shops, Missouri Valley, Iowa. High speed steel of the smallest sizes may be used until it is entirely worn away.

The blacksmith can perform the entire operation. At this shop an old scrap tire is worked out into tool shanks of standard sizes and the toolsmith drives his cutting-off chisel into the end of the tool shank, making a V-shaped pocket, as shown in the illustration. A small piece of high speed steel is then drawn out in wedge form and set into the pocket. The high speed steel wedge is firmly set in the pocket by a blow of the hammer and a thin strip of copper



Tool Shank Ready for Piece of Inserted H. S. Steel

is placed on top, the whole being placed in the fire and allowed to heat. When the temperature is raised sufficiently, the copper fluxes and runs down between the wedge and the side of the V-shaped pocket, practically brazing the wedge in place. After cooling and grinding, this tool may be put to the most severe use on any heavy duty machine and will be found to give satisfactory service.

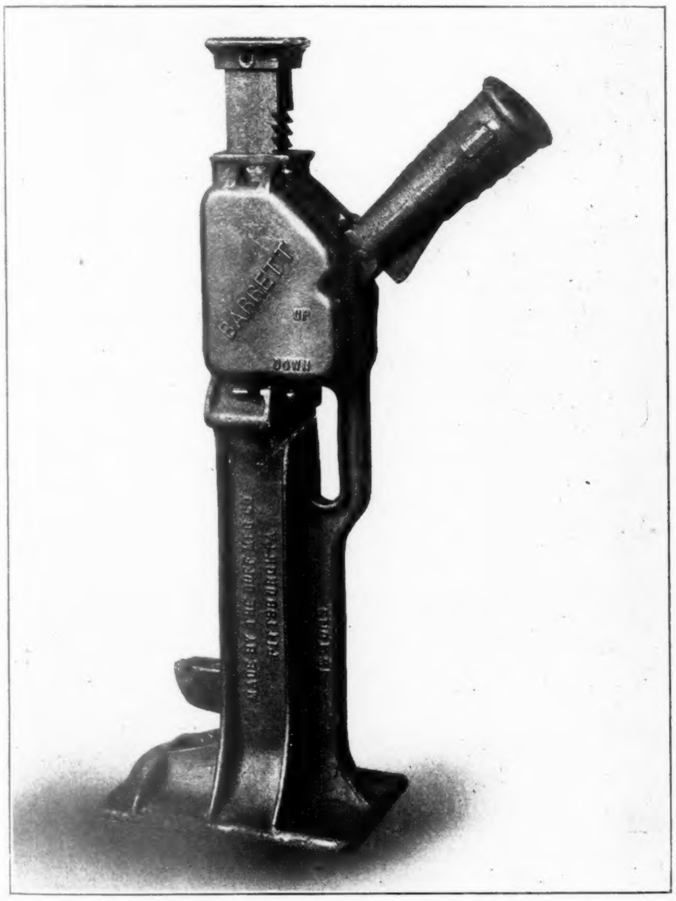
In practical operation tools made in this way at the Missouri Valley shops have been used on driving wheel lathes with good results. Not only does the tool stand up well under the work, but it is economical to use on account of the saving of small high speed steel bits which would otherwise be scrapped.

ELECTRIC WELDING FOR SHIPBUILDING.—A steel ship was recently launched in London which is the first to be constructed without rivets, the plates being welded together by the electric welding process.

# NEW DEVICES

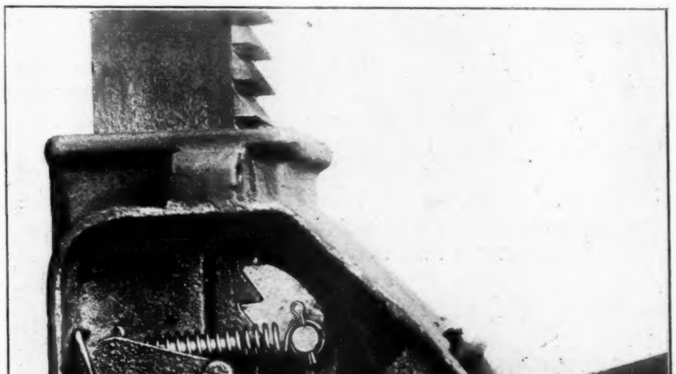
## A NEW CAR JACK

For about 20 years the Duff Manufacturing Company, Pittsburgh, Pa., has made the Barrett car jack No. 19. A new and improved model of this jack, known as the Duff No. 219, has recently been placed on the market. The best characteristics of the old jack have been retained and combined with new and important improvements designed to reduce the wear and to increase the ease with which the jack is operated.



New Barrett Car Jack

With the No. 219 jack it is possible to handle heavier equipment than with other plain ratchet jacks of equal capacity. This is due principally to the use of a fine tooth-lifting rack which decreases the amount of raise for each stroke of the lever and reduces the pressure required by about 30 per cent. Departing from the customary method of making the rack from the square section, the rack of this jack is made from a rectangular section, the thickness from front to back being increased sufficiently to make allowance for the removal of metal in cutting the teeth. The double-pointed pawls distribute the lifting pressure evenly over two of the rack teeth so that each tooth bears only one-half of the load. When in mesh with the rack, the pawls occupy a true vertical position, eliminating side thrust, and reducing wear between the rack and the rack channel to a minimum. The socket lever is made of steel in one piece, the lower end containing the pawl bearing and the trunnion being case-hardened. The use of heavy fulcrum trunnions, cast integral with the socket lever, instead of the customary fulcrum pin, does away with the fulcrum pin-hole which weakens the socket lever at a point subject to heavy strain. Closed-end, refillable, grease-packed bushings are used in order to protect the trunnions against excessive wear by affording efficient lubrication.


Operating Mechanism of Barrett Car Jack

The pawl bearing at the end of the socket lever is

shrouded, providing a guide at both sides and preventing excessive wear caused by sideways rocking of the pawl, as in socket levers having a center guide only. The jack frame is ribbed both front and back and the base plate has similar reinforcement.

The reversing mechanism is strong, simple and compact. Instead of an eccentric, a locking lever is used for shifting the position of the reversing lever. Pivoted on the reversing lever is the spring lever, to each end of which is attached a spring-controlled rod connecting with the two pawls. The cam lever is fastened firmly to the socket lever and operates the spring lever. There are no small or intricate parts to become lost or broken, and the entire mechanism can, if desired, be replaced as a unit.

Loss or breakage of the shield which covers the reversing mechanism will not affect the operation of the jack in any way.

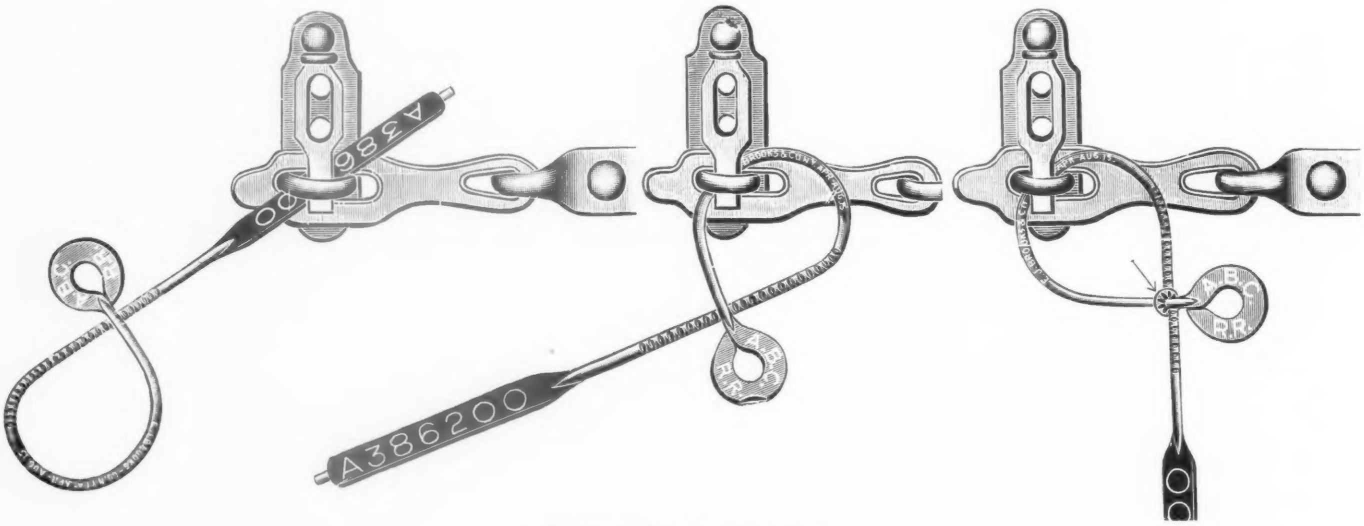
The Duff No. 219 jack is single acting, 28 in. high, having a capacity of 15 tons and a raise of 17½ in. A similar jack, No. 339, is 6 in. shorter and has a correspondingly shorter raise.

## A SELF-LOCKING CAR SEAL

A car seal of the self-locking type with no hidden parts has recently been developed by E. J. Brooks & Co., Inc., New York City. It consists of a single piece of steel wire, looped and flattened at one end, on which is stamped the name or the railroad, and flattened at the other end to receive the serial number.

The method of applying and locking the seal is clearly shown in the illustrations. After being properly inserted through the hasp lock of the car door the seal is locked by twisting the vertical end of the wire about the horizontal end near the flat loop. On the side of the vertical portion of the wire which comes on the inner or compression side of the twisted loop formed in locking the seal, is a series of nicks which insure that the seal may be locked without danger of breaking the wire. To unlock the seal this loop is simply untwisted and the nicked side of the wire is thereby brought into tension, which insures that the seal cannot be unlocked without breaking. A similar series of nicks is placed on the back side of the horizontal portion of the seal to prevent the possibility of successfully tampering with the seal should an attempt be made to lock it by twisting the horizontal portion of the wire about the vertical.

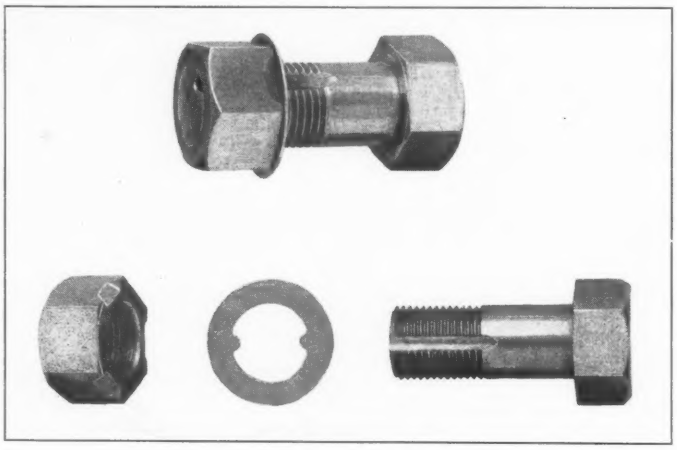
This seal has been in use on one of the eastern railroads for some time.




Brooks Twist-Lock Car Seal

## STEVENSON NUT LOCK

The most severe test that can be given any nut locking device is to use it at a busy railway crossing on rail and frog bolts. Such a test has been made of the Stevenson Permanent nut lock, manufactured by the Permanent Products Company, Cleveland, Ohio. The results of the test were satisfactory; for a period of a year, none of the bolts and nuts applied became loose. The illustration shows the arrangement of the Stevenson nut lock and its simple construction. The bolt has tapered grooves on opposite sides, the grooves being deeper at the point of the bolt and gradually lessening in depth. The washer used has two inner extending lugs to fit the grooves on the bolt. The nut has recesses on three of its outer edges to receive the upset portion of the outer rim of the washer after the nut has been tightened.



Stevenson Permanent Nut Lock.

The construction indicated insures the easy application of the washer to the bolt before applying the nut, as the washer lugs do not begin to touch the base of the grooves on the bolt until the washer has passed on to the bolt about one-half the length of the tapered portion. When the washer is finally forced up against the work, it binds in the base of the grooves without engaging the threads. When the nut has been tightened sufficiently it is securely locked in position by upsetting the outer rim of the washer into one of the recesses on the nut. The nut may be removed with a wrench, but if the washer is to be used again, it is better to first straighten out the upset portion with a cape chisel.

# Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 7,350 copies were printed; that of these 7,350 copies 6,103 were mailed to regular paid subscribers, 410 were provided for counter and news companies' sales, 192 were mailed to advertisers, 67 were mailed to employees and correspondents, and 578 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 70,750, an average of 7,861 copies a month.

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The use of anthracite by the railways of Canada must be reduced this coming winter by about 60 per cent. This is an order from the Canadian Railway War Board directing the roads to use no anthracite in stations or elsewhere, except in Baker heaters in passenger cars, when heat from the engine is unavailable. Ordinarily the Canadian roads would use nearly 100,000 tons of anthracite yearly.

In Circular No. 4-A, dated August 1, and superseding Circular No. 4, issued July 8, the executive committee of the Master Car Builders' Association gives the following instructions to members: When empty cars of 60,000 lb. capacity or over are placed on shop or repair tracks for repairs, they must not be returned to commercial service until they have been placed in condition to meet M. C. B. inspection without exceptions, including U. S. safety appliance requirements.

Under an order of the Fuel Administration, effective August 17, there may be added to the government mine price of coal delivered directly from mine tipples to locomotive tenders the sum of five cents a net ton, or such other sum as may be agreed upon between the operator and the railroad receiving the coal. In case of failure to agree the operator shall furnish such coal at the government mine price, plus such additional sum as may be fixed by the Bureau of Prices of the Fuel Administration.

The New York law (section 77 of chapter 649) requiring locomotives to have automatic fire doors and "vestibule" cabs applies to any locomotive operated by steam. The act will go into effect January 1, 1919, unless the director general or his representative shall otherwise direct. All new locomotives placed in service after the act takes effect must be equipped, and all existing locomotives must be so equipped the first time they are shopped for general repairs.

The National Research Council, acting as the Department of Science and Research of the Council of National Defense, has appointed a committee to investigate the fatigue phenomena of metals. H. F. Moore, professor of the engineering experiment station of the University of Illinois, is chairman. The committee is charged with the responsibility of developing a knowledge of the strength and durability of metals subjected to repeated stresses, such as ship structures, crank shafts of aircraft engines, and heavy ordnance. According to present plans the experimentation required will be done in the laboratories of the University of Illinois under the personal direction of Professor Moore.

### Side Bearings for Standard Locomotives

In the issue of the *Railway Mechanical Engineer* for July it was stated that the orders for side bearings for the tenders of all the standard locomotives ordered by the Railroad Administration had been awarded to A. Stucki & Company. This order has since been changed and the "Tip-roller" side bearings made by Edwin S. Woods & Company, Chicago, have been specified instead. The awards for side bearings for the cars remain unchanged.

### A Twenty-five Million Dollar Government Shop to Be Built in France

The importance of railroad guns is indicated by an announcement from the War Department that the chief of ordnance has approved plans for the manufacture of the machine tool equipment which the United States government will install in France for the relining of the heavy railroad guns in use by the American forces. The plans call for the expenditure of between $25,000,000 and $30,000,000, possibly more. The machine tools alone will cost between $12,000,000 and $15,000,000, and will consist of gunboring lathes, engine lathes, rifling machines and grinders.

A large number of these gun-boring lathes are designed for a 102-in. swing. To make these lathes, there is under construction at one of the machine tool factories in this country a giant planer 500 ft. long, costing $450,000, and the lathes it will help make will approximate, in the aggregate, $6,500,000.

The relining of guns is one of the important salvage operations in the war, saving time and money. Owing to the tremendous heat generated by the charge when the big guns are fired, their accuracy cannot be assured after a few hundred shots unless they are relined, notwithstanding the fact that all other parts except the lining are practically as good as new.

### Recruiting Labor for Railroads

The railroads will not lose out in the campaign now going on to recruit unskilled labor for employers engaged in war work.

The Department of Labor in a statement issued last month said:

While the prohibition against recruiting of unskilled labor by employers engaged in war work, except under the direc-

tion of the Department of Labor, does not include railroads and farmers, the transportation and agricultural industries will be assisted by the United States Employment Service in every way possible.

Specialization in farm and railroad labor supplying is a feature of the central labor recruiting program and the leading branch offices have special railroad labor and farm labor divisions, while in the west and in some places in the south and east, offices have been established which devote their entire attention to supplying farm labor and railroad unskilled labor. Recently the employment offices of railroads in western territory were made a part of the Federal Employment Service system.

This statement is made necessary by the existence of an erroneous belief that railroads and farms must obtain labor through means other than the United States Employment Service. The service will not only assist railroads and farms in getting unskilled labor, but they will be protected by the Department of Labor from recruiting by other industries.

### Equipment Orders for Overseas Service

The United States Government has given an additional order for 500 Consolidation type locomotives to the Baldwin Locomotive Works, for service on the military railway lines in France.

The Railroad Administration's order for 15 additional locomotives from the Lima Locomotive Corporation, reported last month, is for light Mikado locomotives.

It is understood that orders for 10,000 cars for the use of General Pershing's forces will be distributed as follows: American Car & Foundry Company, 2,400; Standard Steel Car Company, 1,900; Haskell & Barker, 1,800; Pressed Steel Car Company, 1,500; The Pullman Company, 1,500; Standard Car Construction Company, 400 tank cars; Liberty Car Company, 250; St. Louis Car Company, 250; all but the 400 tank cars are box cars and gondolas.

### Changes in M. C. B. Interchange and Loading Rules

The executive committee of the Master Car Builders' Association has recently issued Circular No. 6 supplementing the 1917 loading rules. This circular contains modifications of rules 17, 56, 57 and 59 and also the following new rules: Rule 88 covering the manner of loading metal plates in gondola cars; Rule 112-C on loading wrought iron pipe 12 in. or less on flat cars; Rule 117-B on the manner of securing concrete culvert pipe loaded on flat cars, and Rule 125 on the manner of loading metal sheets in box cars.

Circular No. 9 announces the extension of the date effective of paragraphs d, f, h, and i of Rule No. 3 to October 1, 1920, and the elimination of paragraph k of Rule 3, effective July 15, 1918.

The executive committee has also issued the following circular relating to the defect carding of cars offered in interchange: "The M. C. B. rules in reference to defect carding of cars in interchange are modified as follows: (a) Defect carding for any delivering line defects, as between government controlled roads for defects on cars belonging to non-government controlled roads and private car lines as well as cars belonging to government controlled roads is discontinued. (b) Defect carding for any delivering line defects on cars belonging to non-government controlled roads and private car lines is limited to the first and last government controlled road receiving or delivering the car."

## MEETINGS AND CONVENTIONS

*Meeting to Discuss Fuel Economy in Stationary Plants.*—A meeting has been called by Eugene McAuliffe, manager Fuel Conservation Section, Division of Operation, United States Railroad Administration, of one delegate from each railroad operating 500 or more miles of line for the purpose of discussing fuel conservation in stationary plants. The meeting is to be held at the Dearborn Hotel, Chicago, at 9:30 a. m., on Monday, September 9. The delegates are to be selected with regard to their direct responsibility for fuel consumption on other than locomotives. The mechanical engineering staff of the United States Fuel Administration, Department of Conservation, headed by David Moffet Myers, will attend the meeting, and deliver a series of short, concise addresses on the proper maintenance and operation of stationary plants. There is a great opportunity of saving fuel along these lines. In 1918 the railroads consumed in this manner approximately 16 million tons of coal costing about $56,000,000. The meeting will last only one day and is held a day before the Traveling Engineers' Association convenes in order that the men attending may have an opportunity to attend that convention.

*The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:*

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

## RAILROAD CLUB MEETINGS

| Club | Next Meeting | Title of Paper | Author | Secretary | Address |
|---|---|---|---|---|---|
| Canadian | Sept. 10, 1918 | ........ | ........ | James Powell | P. O. Box 7, St. Lambert, Que. |
| Central | Sept. 13, 1918 | Educating Road Foremen, Engineers and Firemen | F. J. Barry | Harry D. Vought | 95 Liberty St., New York. |
| Cincinnati | Nov. 12, 1918 | Annual Meeting | ........ | H. Boutet | 101 Carew Bldg, Cincinnati, Ohio. |
| New England | Oct. 8, 1918 | ........ | ........ | W. E. Cade, Jr. | 683 Atlantic Ave., Boston, Mass. |
| New York | Sept. 20, 1918 | Architecture and Erection of Notable Bridges | C. E. Fowler | Harry D. Vought | 95 Liberty St., New York. |
| Pittsburgh | ........ | ........ | ........ | M. J. Hepburn | 102 Penn. Station, Pittsburgh, Pa. |
| St. Louis | ........ | ........ | ........ | B. W. Frauenthal | Union Station, St. Louis, Mo. |
| Western | ........ | ........ | ........ | ........ | ........ |

# PERSONAL MENTION

## FEDERAL ADMINISTRATION APPOINTMENTS

A. F. DUFFY has been appointed assistant manager of the Safety Section, Division of Operation, of the United States Railroad Administration, with office at Washington, D. C., succeeding W. P. Borland, who is now chief of the Bureau of Safety, Interstate Commerce Commission.

GEORGE N. DE GUIRE has been appointed general supervisor of equipment for eastern territory, on the staff of the mechanical assistant to the director of the division of operation.

JOHN MCMANAMY has been appointed general supervisor of equipment for western territory, on the staff of the mechanical assistant to the director of the division of operation, with headquarters at Washington, D. C.

F. P. PFAHLER, mechanical engineer of the locomotive section, has been made chief mechanical engineer on the staff of the mechanical assistant to the director of the division of operation.

J. J. TATUM, manager of the car repair section, United States Railroad Administration, has had his title changed to general supervisor of car repairs.

FRANK J. WHITEMAN, superintendent of safety of the St. Louis-San Francisco, has resigned and has been appointed supervisor of safety for the Southwestern Region, with headquarters at St. Louis.

## GENERAL

GUY J. CONGDON has been appointed supervisor of fuel of the Chicago Great Western, with headquarters at Chicago. Mr. Congdon had been previously employed in the perishable freight department of the Illinois Central, at Chicago.

HARRY K. FOX, whose appointment as mechanical engineer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, was announced in the *Railway Mechanical Engineer* for August, was born in Washington county, Maryland, on October 14, 1881. Mr. Fox was educated in the Washington County Academy, graduating in 1900. In September, six years later, he began his railroad career, entering the service of the Norfolk & Western, at Roanoke, Va., with which company he remained for about three years, following which he entered the employ of the Pennsylvania Railroad, at Pittsburgh, where he remained until November, 1911, when he became draftsman on the Western Maryland, at Hagerstown, Md. In October, two years later, he was promoted to motive power inspector, and in October, 1916, he became chief draftsman. On March 8, 1918, Mr. Fox was appointed engineer of tests of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., which position he held until his promotion to mechanical engineer on July 8.


H. K. Fox

H. C. EICH, superintendent of motive power of the Chicago Great Western, at Oelwein, Iowa, has been appointed general superintendent of machinery, with the same headquarters. A photograph of Mr. Eich and a sketch of his career were published in the November issue of the *Railway Mechanical Engineer* on page 656.

W. A. MCGEE has been appointed mechanical engineer of the New York Central, lines west of Buffalo, with headquarters at Cleveland, Ohio, succeeding M. V. Bailliere, resigned.

JACOB EDGAR MECHLING, whose promotion to superintendent of motive power of the Pennsylvania System, western lines, was announced in the August issue, was born at Butler, Pa., on November 29, 1863. Mr. Mechling was educated in the high school in his native town and in 1880 he entered the employ of the H. K. Porter Locomotive Works at Pittsburgh, Pa., as a machinist apprentice. In April, 1882, he entered the service of the Pennsylvania Railroad at Pittsburgh, as special apprentice. The following year and until May, 1886, he was employed by the Chicago, Milwaukee & St. Paul, following which he returned to the service of the Pennsylvania. Three months later he was promoted to gang foreman of the erecting shop at Pittsburgh, and subsequently became assistant foreman at the shop where he was first employed. Later he was made foreman of the new enginehouse at Wall, Pa., where he demained until May, 1902, at which time he was promoted to assistant master mechanic of the Pittsburgh division, with headquarters at Pittsburgh. Two years later he was promoted to master mechanic of the Vandalia, with headquarters at Terre Haute, Ind., which position he held until his appointment as superintendent of motive power as mentioned above.


J. E. Mechling

D. J. MULLEN, superintendent motive power of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters in Indianapolis, Ind., has had his authority extended over the Chesapeake & Ohio of Indiana.

F. K. MURPHY, assistant superintendent motive power of the Cleveland, Cincinnati, Chicago & St. Louis, also has authority now over the Chesapeake & Ohio of Indiana. His headquarters are in Indianapolis, Ind.

A. P. PRENDERGAST, mechanical superintendent of the Texas & Pacific at Dallas, Tex., has been appointed also mechanical superintendent of the Louisiana Railway & Navigation Company (lines west of Mississippi river) and the Trans-Mississippi Terminal. Mr. Prendergast's headquarters are at Dallas.

W. H. SAMPLE, superintendent of motive power of the Grand Trunk, at Montreal, Que., has been transferred to the western lines, with headquarters at Detroit, Mich., effective August 26.

W. J. TAPP has been appointed fuel supervisor of the

Denver & Rio Grande, with headquarters at Denver, Colo., effective August 19.

F. W. Taylor has been appointed mechanical superintendent of the Missouri, Kansas & Texas of Texas; the Wichita Falls & North Western; the Fort Worth & Denver City; the Wichita Valley; the Houston & Texas Central; the Union Terminal of Dallas, and the Abilene & Southern, with office at Dennison, Texas.

L. H. Turner, superintendent motive power of the Pittsburgh & Lake Erie, has been appointed superintendent motive power also of the Lake Erie & Eastern and the Monongahela Railway, with office at Pittsburgh, Pa.

B. L. Wheatley, master mechanic of the Chicago, Rock Island & Pacific and the Chicago, Rock Island & Gulf, with office at Fort Worth, Texas, has been appointed superintendent of fuel economy of the same roads, with headquarters at Chicago, succeeding H. Clewer, appointed supervisor of the fuel conservation section of the Pocahontas region.

Oscar E. Wolden, assistant fuel supervisor of the Minneapolis, St. Paul & Saulte Ste. Marie, at Minneapolis, Minn., has been appointed acting supervisor, succeeding L. R. Pyle, now on the staff of the Central Western regional director.

### MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. J. Carey, general master mechanic of the Texas & Pacific at Dallas, Texas, has also been appointed general master mechanic of the Louisiana Railway & Navigation Company (lines west of the Mississippi river) and the Trans-Mississippi Terminal, with the same headquarters.

A. J. Davis, master mechanic of the Erie at Hornell, N. Y., has been transferred to the New York division and side lines, having charge of passenger equipment, succeeding F. H. Murray, promoted. His headquarters are in Jersey City, N. J.

M. A. Gleeson, general foreman, locomotive department, of the Baltimore & Ohio, with office at New Castle Junction, Pa., has been appointed master mechanic of the New Castle division, with office at New Castle Junction, succeeding A. H. Hodges, transferred.

William E. Harmison, assistant master mechanic of the Mahoning division of the Erie, has been appointed master mechanic, with headquarters at Kent, Ohio, succeeding William Moore.

Lee R. Laizure, shop superintendent of the Erie at Hornell, N. Y., has been appointed master mechanic of the New York division and side lines, in charge of freight equipment, with headquarters in Secaucus, N. J. He succeeds Thomas S. Davey, transferred.

William Moore, master mechanic of the Erie at Kent, Ohio, has been transferred as master mechanic to the Susquehanna, Tioga and Jefferson divisions, with headquarters at Susquehanna, Pa., succeeding Clarence H. Norton, transferred.

Ralph R. Munn has been appointed assistant master mechanic of the Mahoning division of the Erie, with headquarters at Brier Hill (Youngstown), Ohio, succeeding William E. Harmison.

William F. Murray has been appointed master mechanic of the New Jersey Southern division of the Central of New Jersey, with office at Lakehurst, N. J., to succeed William Montgomery, retired.

Clarence H. Norton, master mechanic of the Susquehanna, Tioga and Jefferson divisions of the Erie, has been transferred to the Allegheny and Bradford divisions, with headquarters at Hornell, N. Y., succeeding A. J. Davis.

### CAR DEPARTMENT

A. E. Calkins, assistant superintendent of rolling stock of the New York Central Lines East, has been appointed engineer of rolling stock of the New York Central Lines, with office at New York. Mr. Calkins is in the service of the corporation, and is not in the operating organization.

I. S. Downing, general master car builder of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind., has had his authority extended over the Chesapeake & Ohio of Indiana.

W. R. McMunn, general car inspector of the New York Central, Buffalo and east, with office in Albany, N. Y., has been appointed assistant to the superintendent of rolling stock, with office in New York, succeeding A. E. Calkins.

Harry W. Maurer has been appointed assistant superintendent of the car department of the Minneapolis, St. Paul & Sault Ste. Marie, with office at Minneapolis, Minn.

### SHOP AND ENGINEHOUSE

John Burns, master mechanic of the Quebec district of the Canadian Pacific, at Montreal, Que., has been appointed assistant works manager of the Angus shops at Montreal, succeeding J. W. Buckland, granted leave of absence.

Thomas S. Davey, master mechanic of the Erie at Secaucus, N. J., has been appointed shop superintendent at Hornell, N. Y., succeeding Lee R. Laizure.

S. G. Kennedy, shop foreman of the Atlantic Coast Line, with office at Sanford, Fla., has been appointed general foreman at Lakeland (Fla.) shops, vice G. F. Richards, resigned.

### PURCHASING AND STOREKEEPING

J. W. Gerber, general storekeeper of the Southern Railway, with office at Washington, D. C., has been appointed general storekeeper also of the Alabama & Vicksburg, the Carolina, Clinchfield & Ohio, the Carolina, Clinchfield & Ohio of South Carolina, the Georgia Southern & Florida, and the St. Johns River Terminal, with headquarters at Washington, D. C.

Ralph P. Moore, purchasing agent of the Duluth & Iron Range, has been appointed purchasing agent of that road and the Duluth, Missabe & Northern, succeeding on the latter road H. Greenfield, with office at Duluth, Minn.

### COMMISSION APPOINTMENT

W. J. Patterson has been appointed assistant chief of the Bureau of Safety, Interstate Commerce Commission, with office at Washington, D. C. Mr. Patterson has been an inspector of safety appliances under the commission for the past four years.

### OBITUARY

C. W. Van Buren, general master car builder of the Canadian Pacific was killed in an automobile accident near Albany, New York, on August 25.

### NEW SHOPS

Hocking Valley.—This road has given a contract to the Austin Company, Cleveland, Ohio, for the erection of a 10-stall roundhouse at Nelsonville, Ohio, to be completed in 75 working days.

Philadelphia & Reading.—A contract has been given to D. S. Warfel, Lancaster, Pa., for putting up a new machine shop at Rutherford, Pa. The building is to be a one-story structure, 20 ft. wide by 158 ft. long, of brick construction on concrete foundation and base, with steel frame roof and steel sash.

# SUPPLY TRADE NOTES

John F. Long, assistant to president, Bruce V. Crandall Service, has received a commission as captain in the engineer corps.

The Toronto office of the Metal & Thermit Corporation has been moved from 103 Richmond street, S. W., to 15 Emily street.

Sylvanus L. Schoonmaker, chairman of the board of directors of the American Locomotive Company, died on August 17 at his summer home at Locust Valley, L. I.

Marshall E. Keig, secretary and treasurer of Harry Vissering & Co., secretary and treasurer of the Okadee Company, and third vice-president of the Charles R. Long, Jr., Company, with office at Chicago, has resigned from those positions and has been given a leave of absence for the period of the war. Mr. Keig has been accepted for service in the signal corps of the army after having been rejected from the artillery, infantry, marines, railroad regiments and navy on account of defective vision. Before entering the railway supply field, Mr. Keig was employed by the Atchison, Topeka & Santa Fe. From 1904 until 1907 he was in the construction and operating departments and in the ensuing five years was in the general purchasing department at Chicago. He has been with the supply companies which he now leaves ever since severing his connection with the Santa Fe.

M. E. Keig

The Q. & C. Company, New York, opened an office in the Claus Spreckels building, San Francisco, Cal., on August 21. This office is in charge of Latham McMullin.

R. S. Brown, who has been with the G. M. Basford Company, New York, since its establishment, two years ago, was made vice-president of that company August 26.

L. R. Boyer, formerly with the United States Bureau of Standards, has entered the service of E. & T. Fairbanks & Co., scale manufacturers, with headquarters at St. Johnsbury, Vt.

The Thomas A. Edison, Inc., primary battery division, has moved its San Francisco office from room 921 Crocker building to room 1205 Hobart building. E. W. Newcomb is in charge.

The Edison Storage Battery Supply Company has moved its New Orleans office from 201 Baronne street to larger and more commodious quarters in the Maison Blanche building, room 911.

H. K. Christie, air brake inspector and instructor of the Pere Marquette, with headquarters at Grand Rapids, Mich., has left the service of that company to enter advertising work with a Chicago agency.

E. R. Wood, formerly eastern representative of the High Speed Hammer Company, Rochester, N. Y., has associated himself with the sales department of the Sherritt & Stoer Company, Inc., Philadelphia, Pa.

The Chicago Pneumatic Tool Company announces the appointment of C. W. Cross as special representative for the sale of pneumatic tools to railroads, succeeding L. C. Sprague, who has been made district manager of sales at New York.

At the last meeting of the board of directors, Le Grand Parish, chairman of the executive committee, was elected president of the Lima Locomotive Works, Inc. Mr. Parish will also retain the presidency of the American Arch Company.

W. H. V. Rosing, formerly in the employ of the St. Louis-San Francisco, has become associated wih the Globe Seamless Steel Tubes Company of Milwaukee, Wis., as assistant mill manager in charge of the engineering and mechanical departments.

The Chicago Pneumatic Tool Company has started work on the construction of an addition to the Cleveland plant, which is planned to double the present output. It is expected that work will be completed on the building about November 1. The necessary equipment has been ordered.

H. E. Chilcoat, representative of the Westinghouse Air Brake Company at its Pittsburgh office, has severed his connection with that company to accept the position of manager of the Clark Car Company, Pittsburgh, manufacturers of the Clark extension side dump car.

The Independent Pneumatic Tool Company has leased the entire sixth floor of the Otis building at 600 West Jackson Boulevard, Chicago, for general offices, and removal was effected about September 1. The new quarters are twice as large as those formerly occupied at 1307 South Michigan avenue.

A. G. Delany, salesman for the American Brake Shoe & Foundry Company, with headquarters at Chicago, has been appointed local manager of that company, at Minneapolis, Minn., where he will have charge of its work and will also look after sales in northwestern territory. Mr. Delany was born at Worcester, N. Y., in 1879. In 1896 he entered the service of the Chicago, Burlington & Quincy as an office boy; later he served for a period of seven years in the Burlington locomotive shops at Chicago, and at Aurora, Ill., following which he was appointed mechanical traveling inspector, having charge of the heating and lighting of passenger cars of both the east and west lines. In 1905 he resigned to become salesman for the Safety Car Heating & Lighting Company, at Chicago, where he remained for three years, following which he went with the Chicago Car Heating Company, as salesman, with headquarters at Atlanta, Ga. In 1911 he left that company to become salesman for American Brake Shoe & Foundry Company, at Chicago, which position he held until his recent appointment as local manager at Minneapolis.

A. G. Delany

The Bird-Archer Company, manufacturer of locomotive boiler chemicals, has moved its Chicago offices to 1105 Peoples Gas building, the change having been necessitated

by larger space requirements. This company has recently increased its manufacturing facilities by opening a new factory in Chicago, and a new factory at Cobourg, Ont., besides materially increasing the output of its Philadelphia factory.

George H. Musgrave was appointed general manager of the Star Brass Manufacturing Company, Boston, Mass., on July 1. Mr. Musgrave has been with this company for more than 30 years, having left the service of the New York & New England Railroad to go to the Star Brass Manufacturing Company. In 1900 he was appointed general sales agent, specializing on railway, marine and naval steam devices.

The Lagonda Manufacturing Company, Springfield, Ohio, announces that the Syracuse (N. Y.) district office in charge of T. X. Lieb, has been moved from 2400 South Salina street to 219 Union Bank building, and that the Cincinnati branch office has been moved from the First National Bank building to 2607 Union Central building. Frank Walmsley, who has handled the Lagonda business in Cincinnati for some time, is in charge.

Press G. Kennett, western railroad sales manager of the Flint Varnish & Color Works, with headquarters at Chicago, has resigned to become manager of the railroad department of the C. R. Cook Paint & Varnish Company, Kansas City, Mo. Mr. Kennett was connected with the Flint Varnish & Color Works for eight years and previous to that had 17 years of railroad experience in the stores and purchasing departments of several lines in the Southwest.

Wilberforce Eckels, who for five years has been assistant western sales manager of the Standard Coupler Company in Chicago, has been commissioned a second lieutenant of engineers. Mr. Eckels is a graduate of Pennsylvania State College, where he took a mechanical engineering course. Owing to the fact that George A. Post, Jr., formerly western sales manager, has been for several months a captain in the ordnance corps, and that now Lieutenant Eckels is also in military service, the company has closed its Chicago office.

The Dearborn Chemical Company, Chicago, announces the inauguration of a specialties department for the manufacture and marketing of a number of specialties of interest to manufacturers of steel products. These specialties have been tested in actual service for two years or more and include a rust preventive known as No-Ox-Id, cutting oils for lubricating the cutting tool and preventing overheating in metal cutting, quenching oils for heat treating, drawing oils, and Dearboline, a preparation for cleaning machined parts of emery or grease.

W. J. Schlacks, vice-president and director of McCord & Co., at Chicago, has incorporated the Locomotive Lubricator Company and has purchased the McCord locomotive lubricator. The new company will manufacture and promote the sale of the Schlacks system of locomotive forced feed lubrication. O. H. Neal and C. W. Rudolph, sales engineers, who have been associated with Mr. Schlacks in McCord & Co., have joined the new company, now located in the Tower building, Chicago. Mr. Schlacks' photograph and biographical sketch appeared in the December, 1917, issue.

The Westinghouse Electric & Manufacturing Company has purchased the property, business and good-will of the Krantz Manufacturing Company, Inc., Brooklyn, N. Y., manufacturers of safety and semi-safety electrical and other devices, such as auto-lock switches, distribution panels, switchboards, floor boxes, bushings. etc. The supply department of the Westinghouse Electric & Manufacturing Company will act as exclusive sales agent for the products of the Krantz Manufacturing Company, Inc., Brooklyn, N. Y., continued under its present name. H. G. Hoke, of the Westinghouse Electric & Manufacturing Company, will represent the supply department at the Krantz factory.

## CATALOGUES

Tanks.—The Walter A. Zelnicker Supply Company, St. Louis, Mo., has issued bulletin No. 246. This is a four-page pamphlet and contains specifications for some of the storage, wooden and car tanks, etc., carried in stock by the company.

Expansion Joints.—The Ross Heater & Manufacturing Company, Buffalo, N. Y., has issued a folder describing and illustrating the Ross crosshead-guided expansion joints, water heaters, condensers and other apparatus manufactured by this company.

Strom Bearings.—Data sheets giving prices and dimensions of all types of Strom bearings have been compiled in a 72-page catalogue by the U. S. Ball Bearing Manufacturing Company of Chicago, to assist purchasers in making selection of the proper bearings for their needs.

Flexible Shaft Couplings.—Bulletin No. 26 of the Smith-Serrell Company, Inc., 90 West street, New York, issued recently, describes the construction and operation of Francke flexible shaft couplings of the heavy pattern type. Directions are given for size selection and installation.

Piston Rings.—Ever-Tight piston rings, which are claimed to increase compression and power and reduce waste of fuel and oil, are described and illustrated in a four-page folder issued by the Ever Tight Piston Ring Company, St. Louis, Mo. The dimensions are given in the pamphlet.

Calculating Bearing Loads.—The U. S. Ball Bearing Manufacturing Company has compiled in a booklet of convenient size, formulae and calculations necessary to determine the loads on ball bearings resulting from various types of power transmitting elements, with sketches illustrating the various bearing loads. These include belt, rope and chain drive loads, spur, helical and bevel gear drive loads, and helical bevel gear and worm gear drive loads.

Portable Forges.—The Buffalo Forge Company, Buffalo, N. Y., has issued a catalogue entitled Buffalo Forges, describing the complete line of portable machines manufactured by that company. In order to simplify the catalogue and make changes and additions easy, it has been punched and the new sections may be attached by suitable brass fasteners. Section No. 108 has recently been issued, to be added in this way. It covers the line of stationary forges manufactured by the company.

The Lubrication of Ball Bearings.—The United States Ball Bearing Manufacturing Company, Chicago, has reprinted in an attractive booklet, an article published in the American Machinist of February 21, 1918, by Otto Bruenauer, director of sales and engineering of the company. Methods of determining the best lubricants to use are described, as well as the proper housing of ball bearings. The text is well illustrated with sketches showing ways of sealing the bearings from dirt and water.

Electric Soldering Irons. — The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., and New York, has issued an eight-page folder describing and illustrating the C-H electric soldering irons and hand tools. Two views are shown of the soldering iron, which has a threaded heating core over which the tip is screwed, and a new automatic rack is explained in detail. A six-inch current regulating plate which provides temperature control where different grades of work are being done, and the C-H 7050 feed-through switch for installation on the heater cord, are also illustrated.